25 MAY 1961

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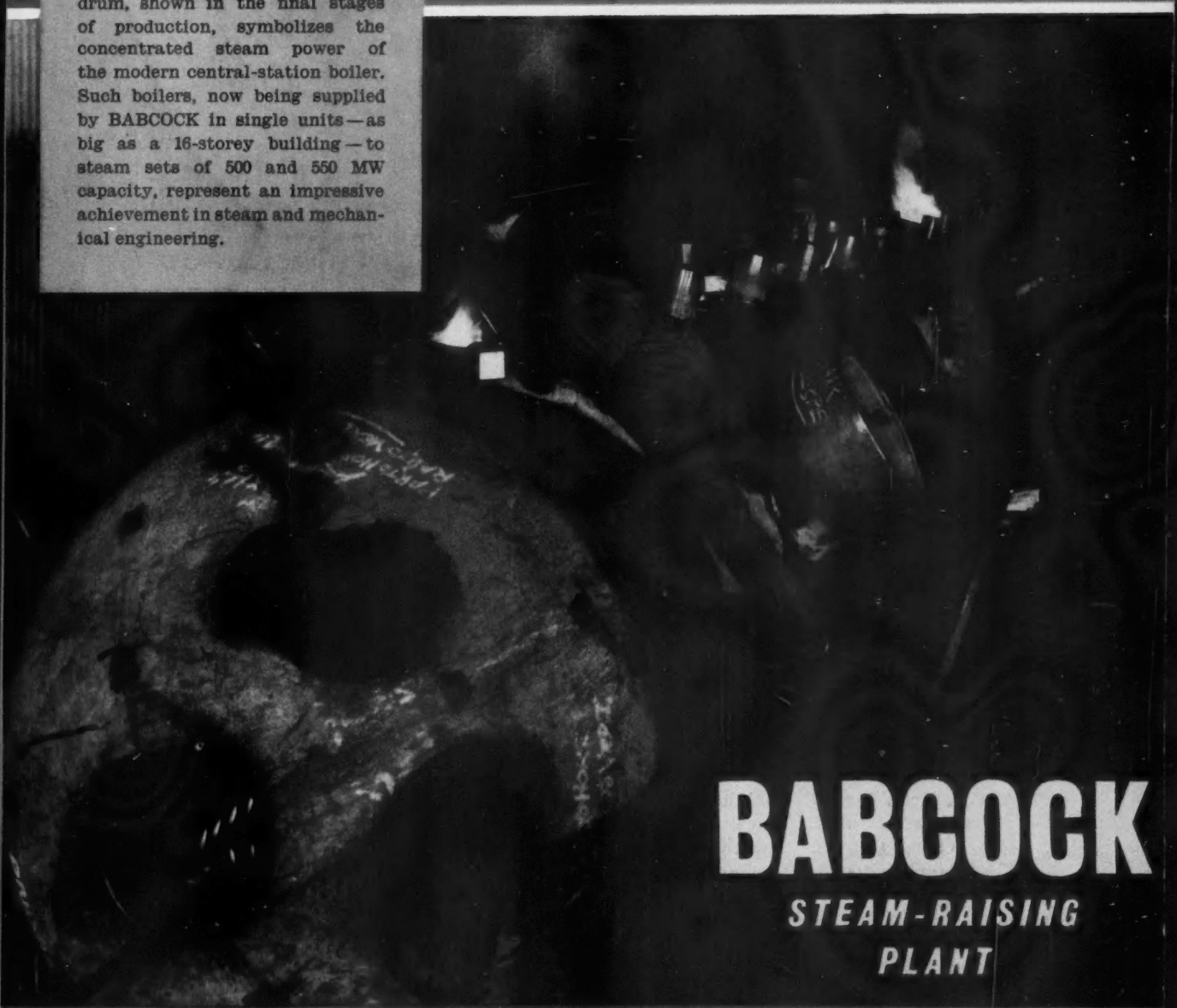
This 150-ton fusion-welded boiler drum, shown in the final stages of production, symbolizes the concentrated steam power of the modern central-station boiler. Such boilers, now being supplied by BABCOCK in single units—as big as a 16-storey building—to steam sets of 500 and 550 MW capacity, represent an impressive achievement in steam and mechanical engineering.



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STEAM-RAISING PLANT

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SAFER IN HALF THE TIME

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Use 'Scotchloks' on all types of electrical joints—the world's surest-gripping wire connector, and the fastest to apply! Fires caused through "tired" connections every year are still too numerous despite close observance of fire regulations. The remedy can cost no more than 2d. a 'Scotchlok' connection.

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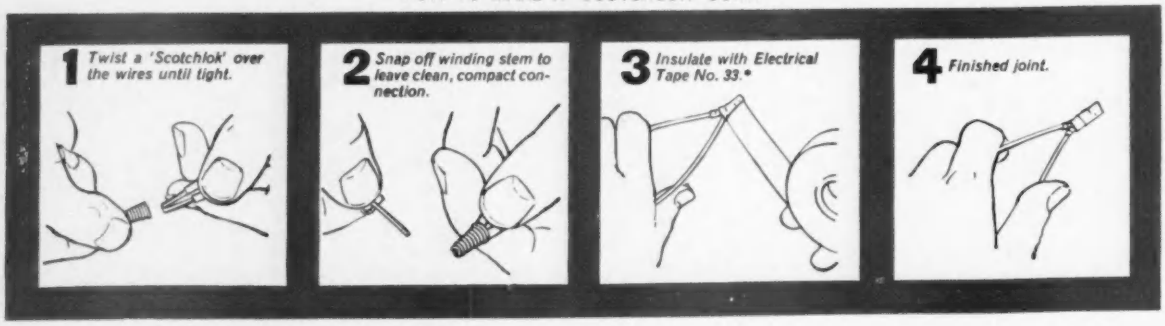
Every electrical joint is a potential danger point so *safeguard with 'Scotchloks' and be sure!* 'Scotchloks' are available in four *uninsulated* and three *preinsulated* sizes.

HOW TO MAKE A 'SCOTCHLOK' JOINT


1 Twist a 'Scotchlok' over the wires until tight.
2 Snap off winding stem to leave clean, compact connection.
3 Insulate with Electrical Tape No. 33.*
4 Finished joint.

* 'Scotch' Brand Electrical Tape No. 33 will effectively insulate any electrical joint with 'wrap-around' security of up to *9500 volts per layer*. It will not harden, become brittle or lose its grip under the most extreme conditions —torture tests prove it.

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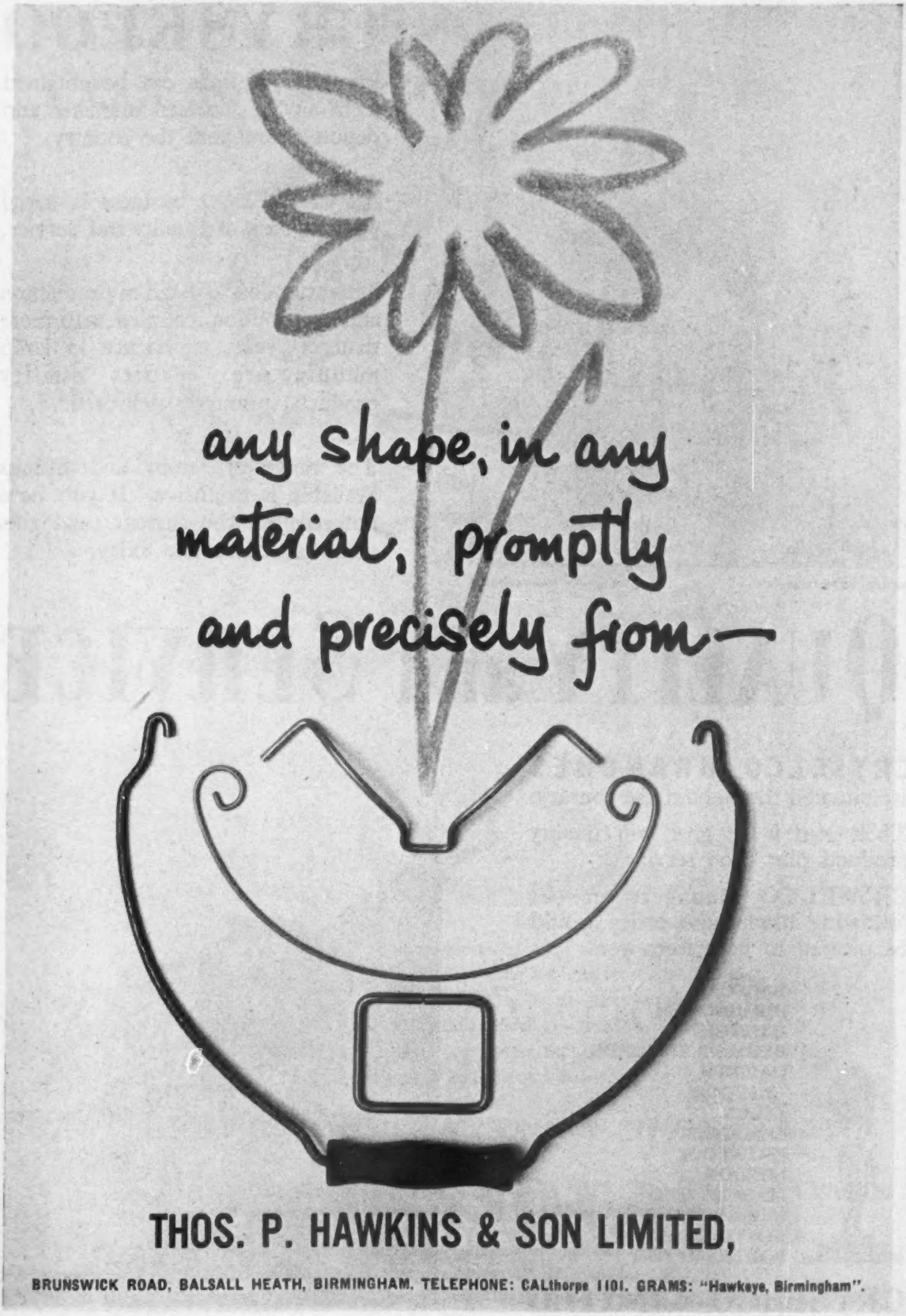
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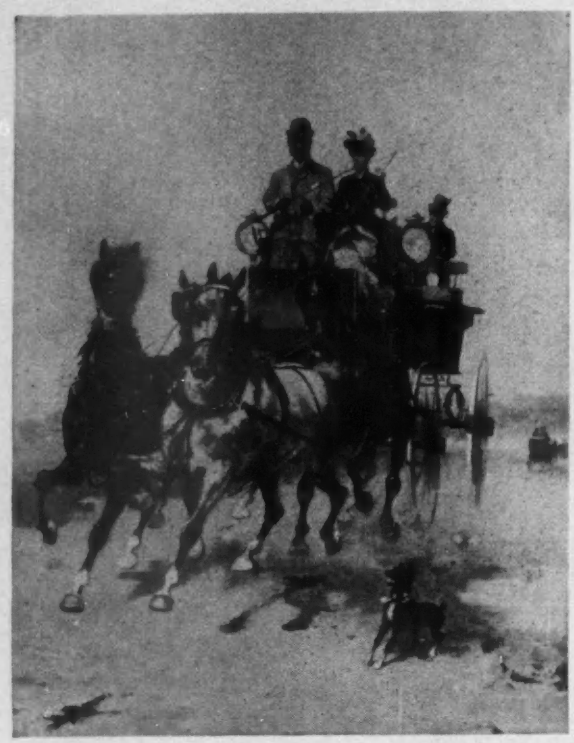

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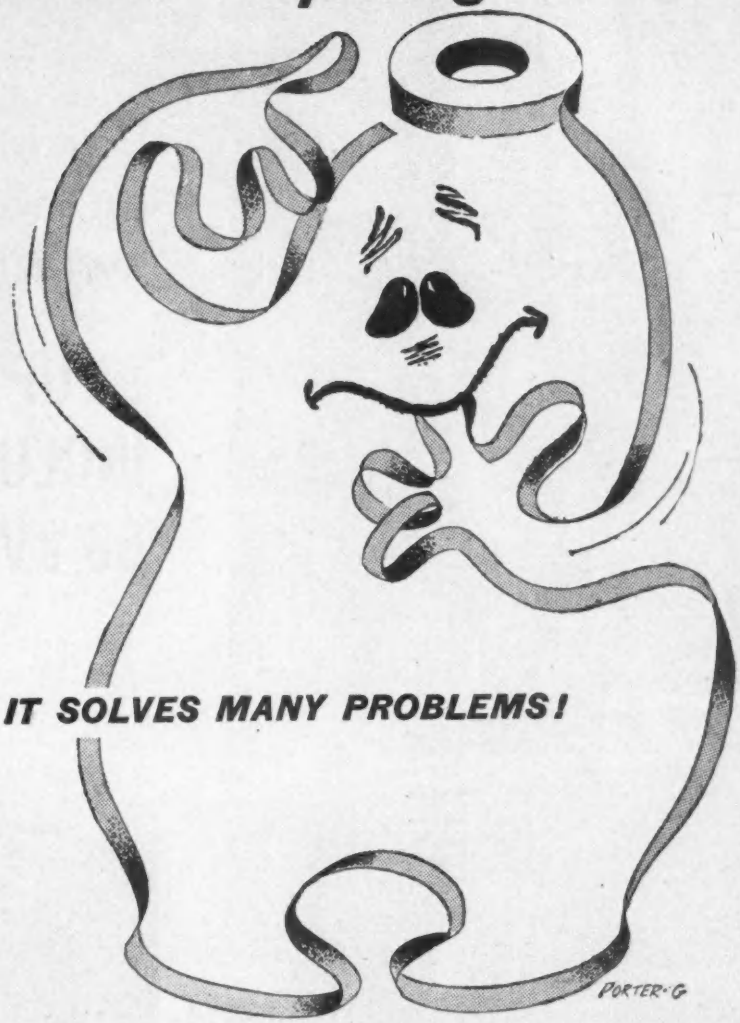

YET IT SOLVES MANY PROBLEMS!

Lasso No. 92 has so many properties, so many uses, we could fill this page with them. And dull reading it would make. A lot of stuff about pliability, water resistance, acid resistance, wrapping, jointing, insulating, binding, splicing — *that* sort of thing. Far better send for our alert young representative, *he* makes it sound interesting. Ask your secretary to drop us a line today.

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for all electrical and industrial uses

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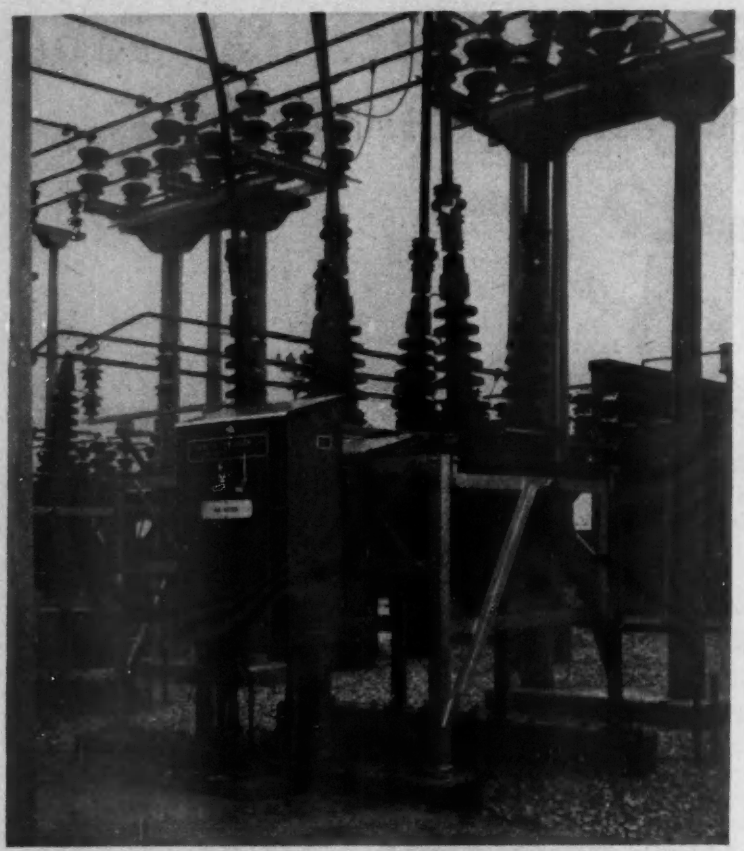

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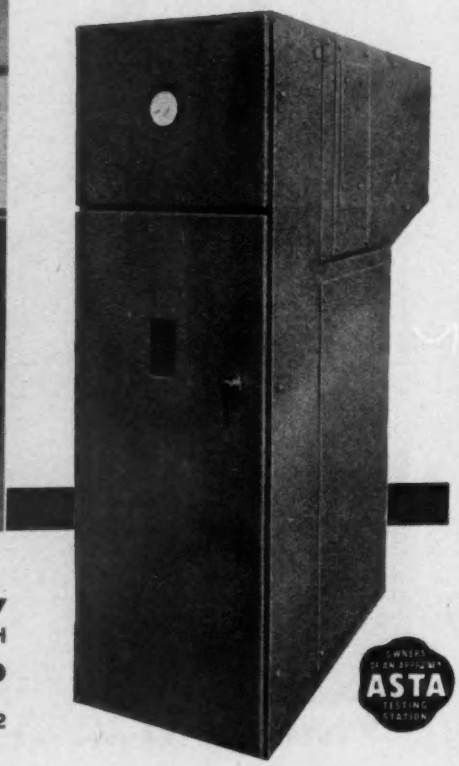

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Aluminium sheathed cables—a growing market

OVER 100 miles of aluminium tube is rolled on to drums like these at Rogerstone, Monmouthshire, every month; it goes to cable makers all over England. More material leaves in the form of strip, for those cable makers who make their own tube by seam welding. These tubes become sheathing for insulated cables.

Four main classes of cable are being made with aluminium sheaths.

Supertension Power Cables

These are filled with gas or oil under pressure. Aluminium sheaths can resist this pressure without reinforcement. Pressure-type cables with aluminium sheaths are notably smaller and lighter, and cheaper, than alternative constructions.

Paper Insulated Power Cables

Aluminium sheathed cables are being increasingly used for power distribution in factories of all kinds. The advantages of aluminium over other cladding materials include—lightness, strength, economy, good resistance to corrosion, and the ability to withstand vibration.

Rubber or Plastic Insulated Wiring Cables

In factories or office buildings, aluminium sheathed cables provide neat and cheap installations; many orders today are repeat orders from satisfied customers.

Telecommunication Cables

Here aluminium's advantage is its good conductivity. An aluminium sheath screens the communication circuits against interference from near-by power cables, and prevents dangerous build-up of induced voltages.

Ask your cable supplier to quote you for aluminium sheathing next time you enquire for cables. For further information write to: Alcan (U.K.) Limited, Aluminium Canada House, 30 Berkeley Square, London, W.1. Telephone MAYfair 9721.

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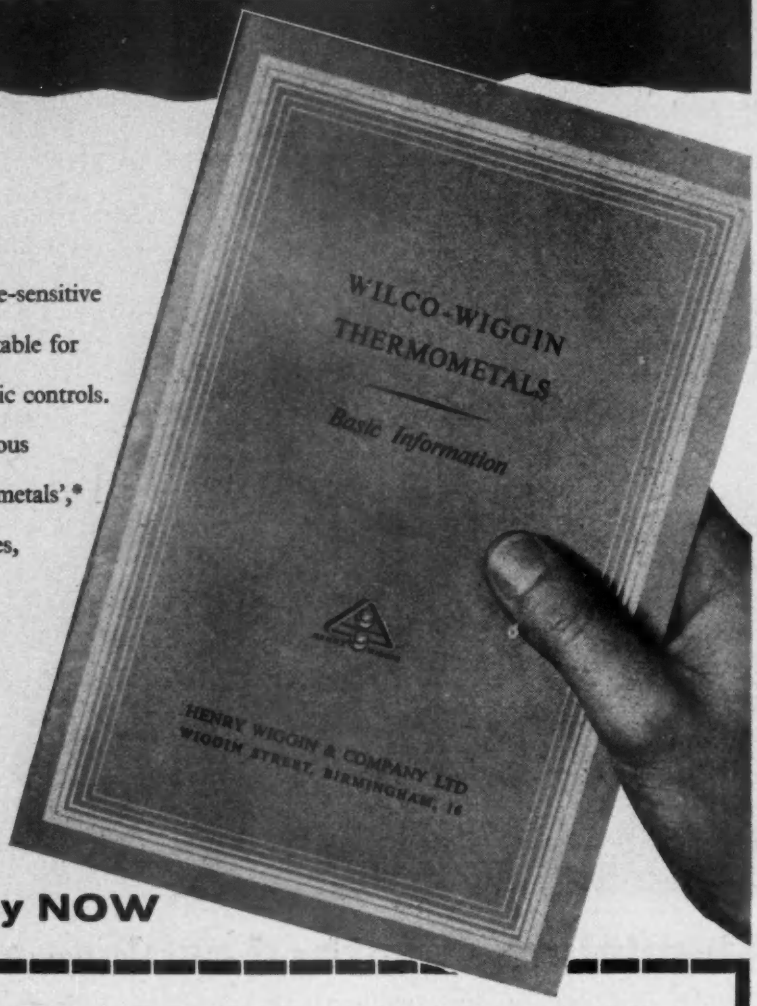
WILCO-WIGGIN Thermometals



THERMOMETALS are temperature-sensitive bimetals produced in several grades suitable for use in a wide variety of thermostatic controls. This new publication describes the various grades of 'Wilco-Wiggin Thermometals',* with tables of thermal properties, design formulæ for various types of mechanism, and details of fabrication and heat-treatment.

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NEWS SHEET

L. Rotherham heads CEGB committee investigating SE England breakdown. Minister of Power tells Commons that technical aspects were complicated and full investigation will take some time. (821, 848)

Calder Hall generates 25% more power than design value. Increased heat output from reactors makes this possible. Turbines rebladed to use extra steam. Similar improvements at Chapelcross. (849)

IEE membership 47,422 at end of March, states annual report. Year marked by completion of reconstruction of IEE building costing £400,000. Wiring regulations committee active on amendments to 13th edition; fourth edition of ship electrical regulations promised soon. (840)

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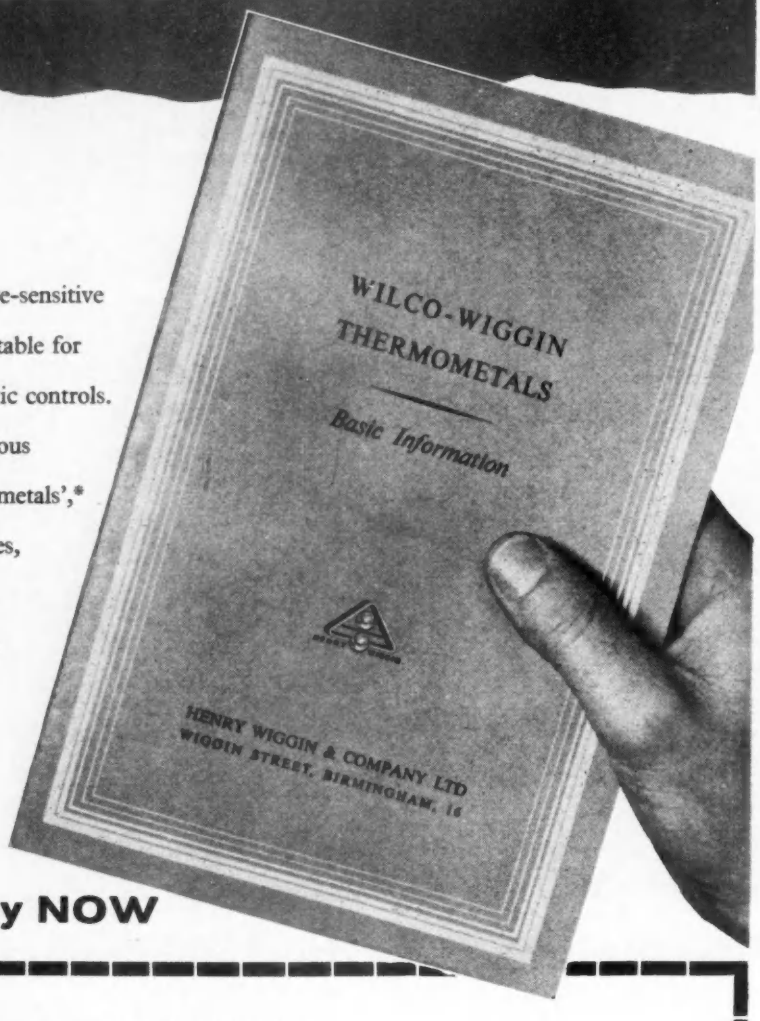

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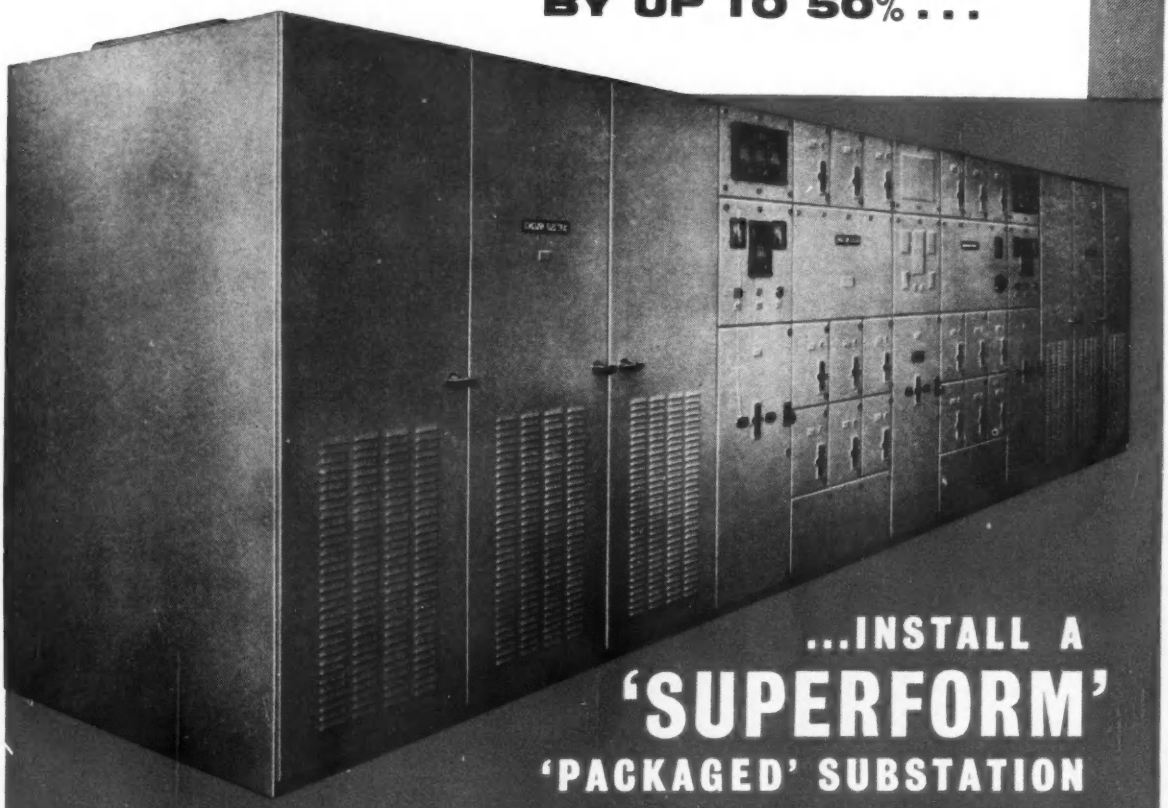

. . . INSTALL A 'SUPERFORM' 'PACKAGED' SUBSTATION

Incorporating DRY TYPE TRANSFORMER(S)

The illustration shows a 'Superform' 'Packaged' Substation for a large chemical works. Two 1,000 kVA Class 'C' dry type transformers are incorporated, one at each end of the equipment. The medium voltage switchboard is supplied through two air circuit-breakers, and the outgoing circuits are controlled by on-load h.r.c. fuse-switches.

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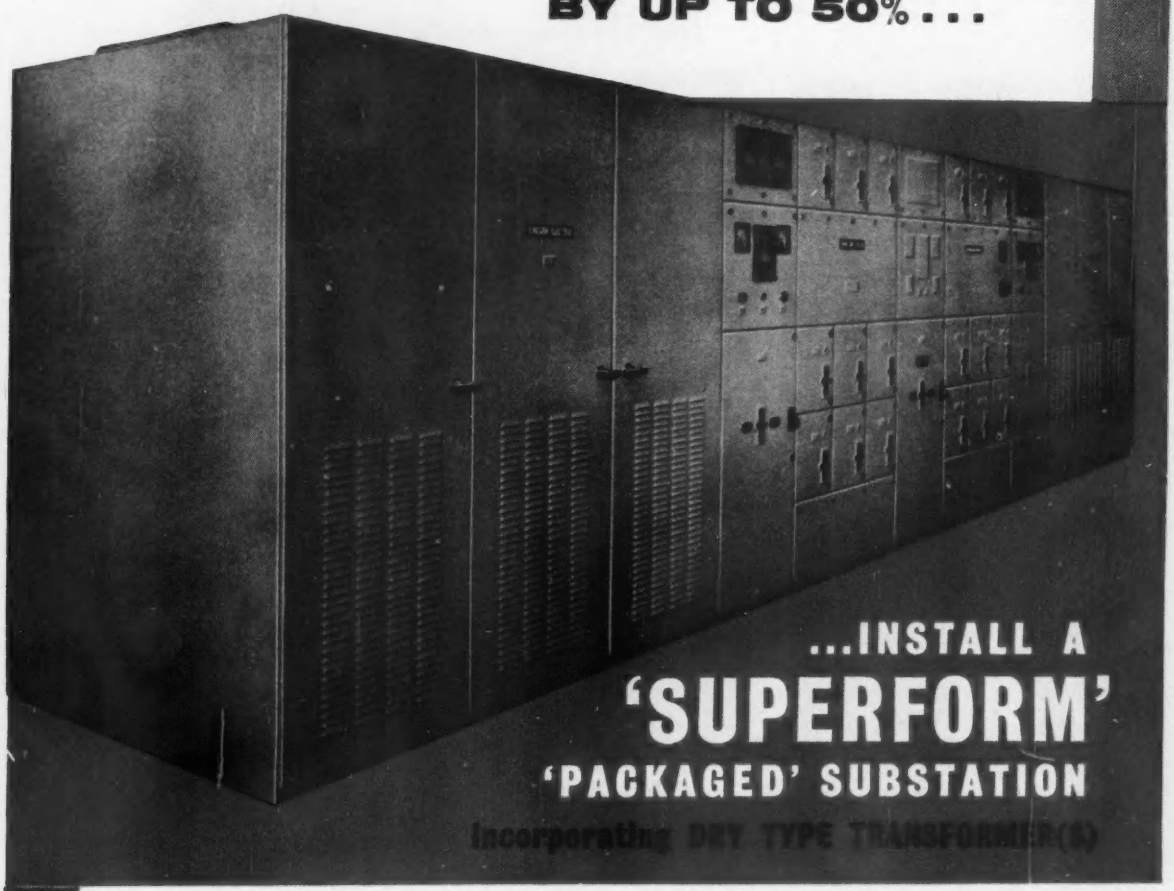

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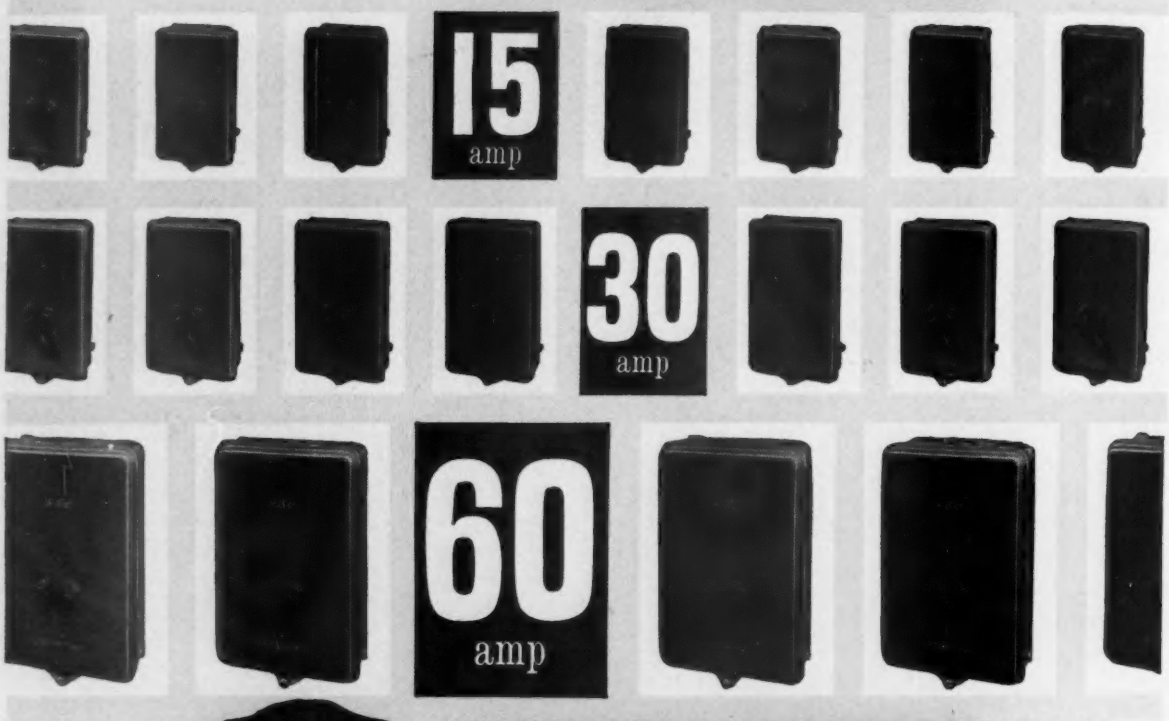

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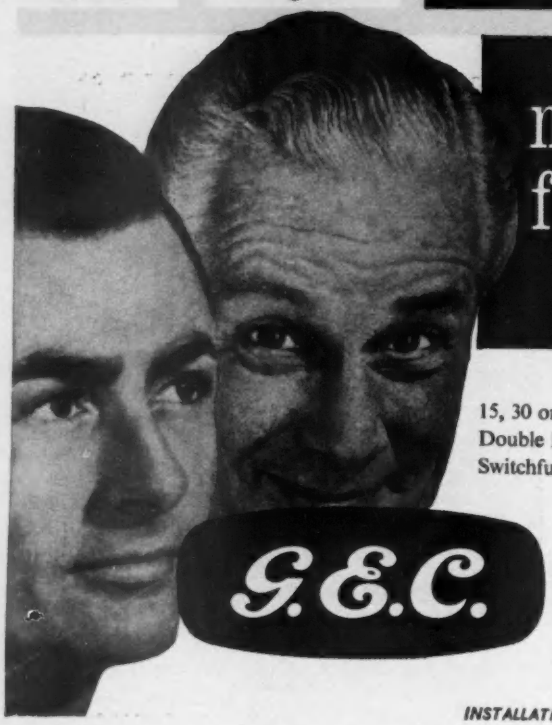

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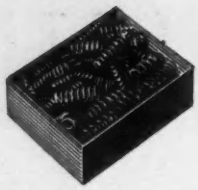
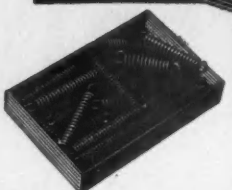
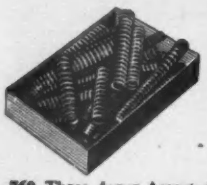


No. 98A. Three dozen Assorted 1" to 4" long, ¼" to ½" diam., 19G to 15G. **6/6.**

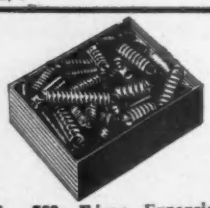


No. 753. Three dozen Assorted Light Expansion ½" to ¾" diam., 2" to 6" long, 22 to 18 S.W.G. **12/-.**



No. 760. Three dozen Assorted Light Compression Springs. 1" to 4" long, 22 to 18 S.W.G., ¼" to ½" diam. **7/6.**

No. 757. Extra Light Compression, 1 gross Assorted, ⅛" to ⅜" diam., ½" to 2¼" long, 27 to 19 S.W.G. **18/-.**



No. 758. Fine Expansion Springs. 1 gross Assorted ¼" to ¾" diam., ½" to 2" long, 27 to 20 S.W.G. **18/-.**

That spring you want . . . in a hurry . . . *where* is it? Pick *what* you want *when* you want it from TERRY'S BOXES OF ASSORTED SPRINGS—our fine range of small boxed assortments of experimental springs. We can show you only a few from the range here. Send a postcard for our full list—and if ever you're stuck with a spring problem send it along to our Research Department —they'll gladly help you out.

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If so, the help of our Design Staff is yours for the asking.

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Really interested in Springs? "Spring Design and Calculations" 11th Edition tells all—post free 12/6.

Cut Production Costs with Terry's Wire CIRCLIPS. We can supply immediately from stock—from ⅛" to ⅝".

Looking for good Hose Clips? Send for a sample of Terry's Security Worm Drive Hose Clip and price list.

HERBERT TERRY & SONS LTD

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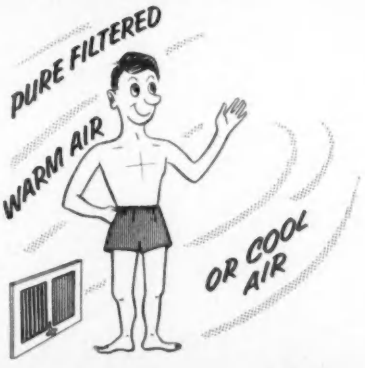
(Makers of Quality Springs, Wireforms and Presswork for over 100 years)

HT31



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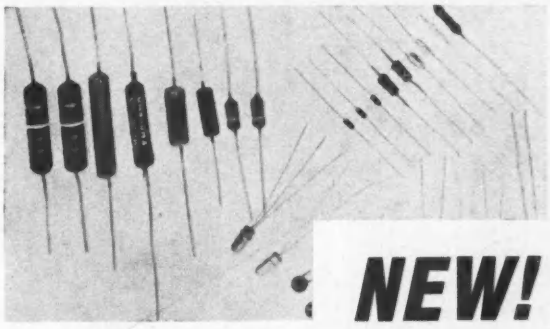

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FROM REJAFIX FOR MARKING, PRINTING AND COLOUR-BANDING

THE FA-72 AUTOMATIC MACHINE with special feeding device for printing and colourbanding on components with co-axial wire leads.

AN AUTOMATIC TRANSISTOR PRINTER with much increased output for marking and printing on transistors of various shapes and sizes down to the smallest.

★ ★ ★

There are many other machines in the REJAFIX range, which runs from fully automatic down to hand-operated models. It includes machines suitable for marking on components of many different types and special machines for colourbanding on articles such as small resistors, fuses, etc. We should be pleased to discuss your problems.

AT STAND 359 RADIO & ELECTRONIC COMPONENT SHOW

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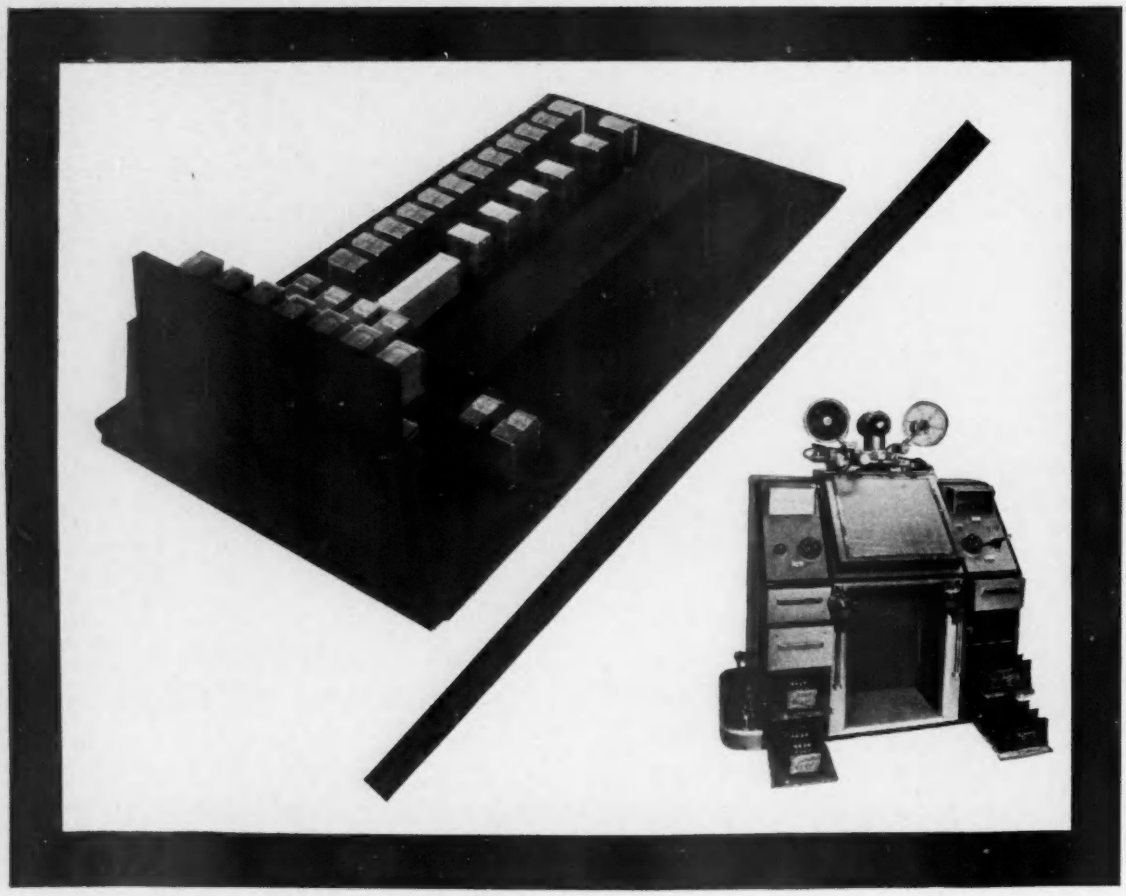
You'll find FORMICA Industrial laminates in all the best of British products from the smallest radio to the largest machine. High quality is backed by an unsurpassed technical service, and Formica Limited make paper, glass, fabric and copper clad laminates, engraving material and inter-laminate prints.

FORMICA* INDUSTRIAL LAMINATES

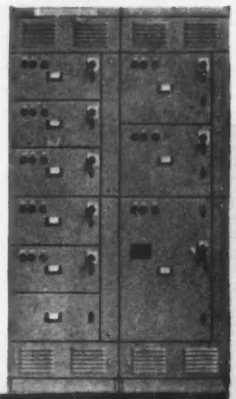


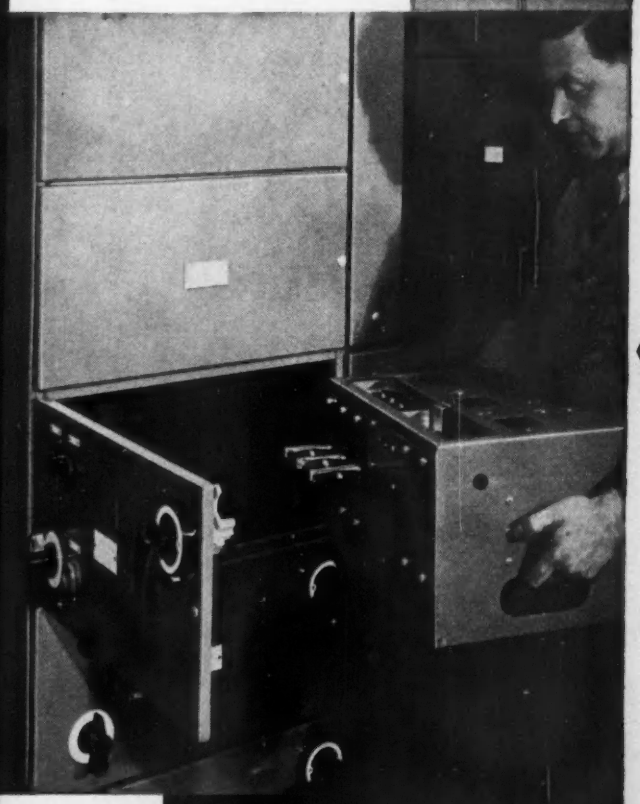
For full information on FORMICA Industrial laminates write to:

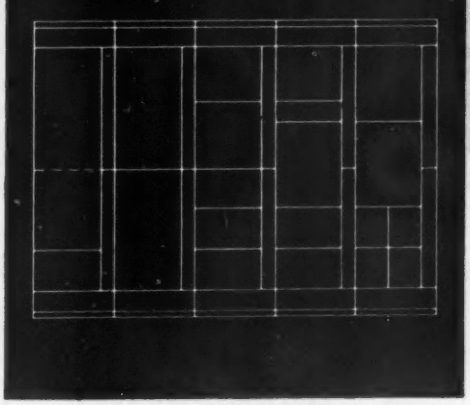
FORMICA LIMITED (Industrial Laminates Division)

84-86 REGENT STREET, LONDON, W.1.
TELEPHONE: REGENT 8020

*FORMICA is a registered trademark

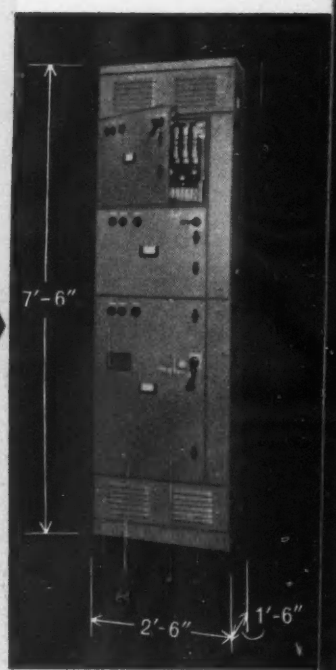






ONLY THE G.E.C. MOTOR CONTROL CENTRE IS SO COMPACT SO EASY TO INSTALL

- **Starter trays can be unplugged, withdrawn and replaced after cubicle shell is in position**
- **Starters up to 200 h.p. at 550V and 150 h.p. at 400 V can be included as a standard feature, and matching equipment of unlimited range can be supplied**
- **All boards can be broken down into easily-handled single-cubicle sections with maximum dimensions of 1'6" x 2'6" x 7'6" high**
- **18" deep cubicles save space**
- **Designed around a number of basic starter sizes to make the most use of space and give flexibility. (One vertical cubicle section will accommodate 12 starters up to 7½ h.p. or 6 starters of up to 15 h.p.)**



In addition, the G.E.C. Standard Motor Control Centre gives:

EXTRA SAFETY
All doors interlocked with the unique G.E.C. 3-position isolating switch

MAXIMUM FLEXIBILITY
All starter units are interchangeable

EASY SERVICING
Self-aligning plug-in system enables easy replacement and servicing of any unit while Centre is in action

QUICK DELIVERY
Within 12 to 16 weeks of order

Call in a G.E.C. technical representative for further information and advice. (Phone Birmingham East 1941 Extn. 342).

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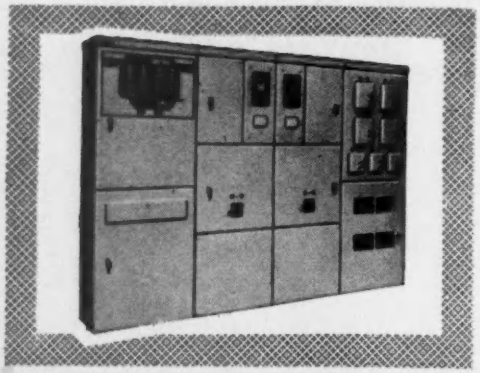
RELY ON THE EXPERIENCE OF G.E.C.

the first Company to make this type of Motor Control Centre in the U.K.

THE GENERAL ELECTRIC COMPANY LIMITED OF ENGLAND SWITCHGEAR DIVISION BIRMINGHAM 6

Simplex leadership stems from vast experience, sheer technical efficiency and a team of brilliant designers. It is the blending of these merits that has produced superb ranges of switchgear. Simplex Star, Regent and Monarch ranges, and S & S automatic control gear, along with circuit-breakers, etc., can be assembled to satisfy your needs for every industrial and commercial requirement. Simplex design service is always at your disposal from a simple switchboard to the most complicated made-to-measure task.



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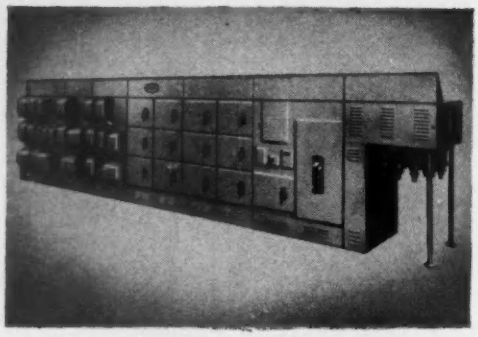

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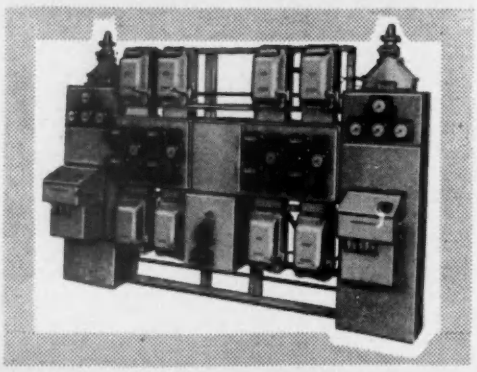

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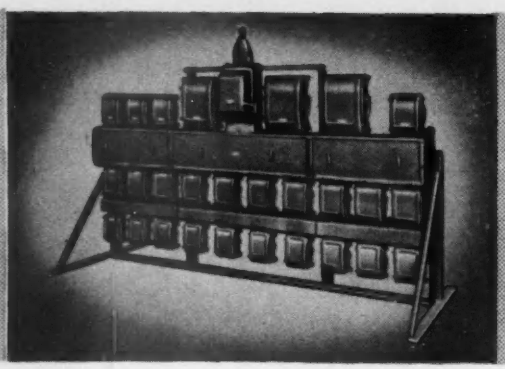

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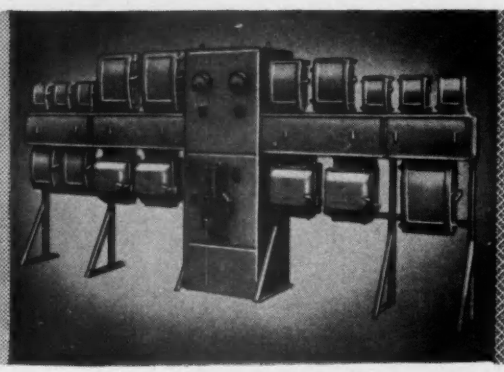

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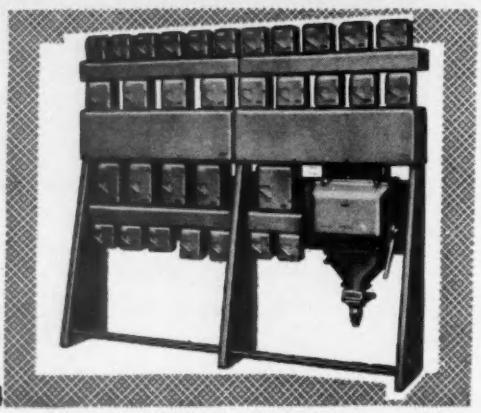


4

ELECTRICAL DIVISION

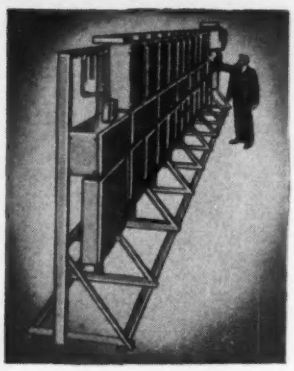
Simplex

SIMPLEX ELECTRIC COMPANY LIMITED

CREDA WORKS, BLYTHE BRIDGE, STOKE-ON-TRENT, STAFFS.

Branches throughout Great Britain and Agents throughout the World

Simplex Switchboards



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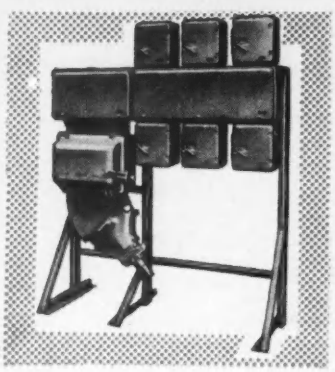

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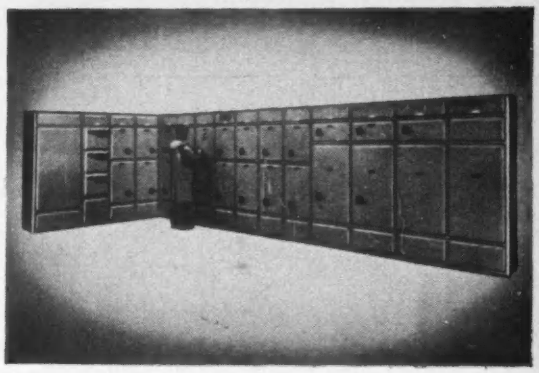


9

1 Cream coloured cubicle type Switchboard, incorporating mimic diagram of floor-warming circuits, made up of Star and S & S installation switches controlling all electrical services at a dock's reception area.

2 Star Monarch and Automatic Control Gear switchboard designed to control all services (and Floor-warming) for a Comprehensive School, Menai.

3 Specially designed switchboard incorporating Monarch units supplied to a Gas Board.

4 Multi-tier Star switchboard with incoming Monarch unit controlling kitchen in a Commercial Building, Birmingham.

5 Multi-tier Regent switchboard with Monarch incoming unit for an International Airport.

6 Switchboard built up with Regent and Monarch units designed for a Bristol Factory.

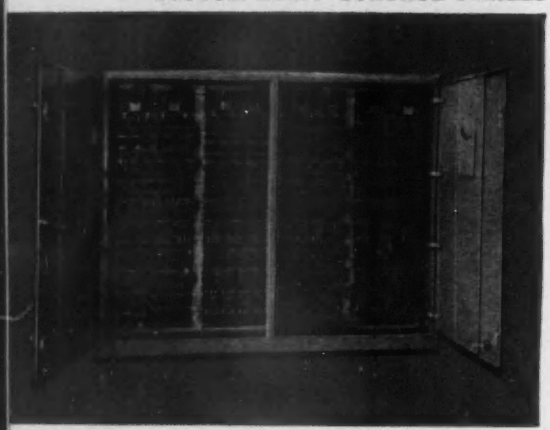
7 Busbar mounted multi-motor starterboard for an oil refinery.

8 Star switchboard with Monarch incoming unit (with angled sealing chamber) supplied to a factory.

9 Multi-motor control cubicle for an oil storage installation, London.

Whichever way

CUSTOM-BUILT CONTROL PANELS



If ever there was a case of "no set answer" it is in the field of automatic controls.

You may require custom-built control panels, or you may prefer to build up your own control systems from individual M.T.E. components, channel framework and standard cabinets.

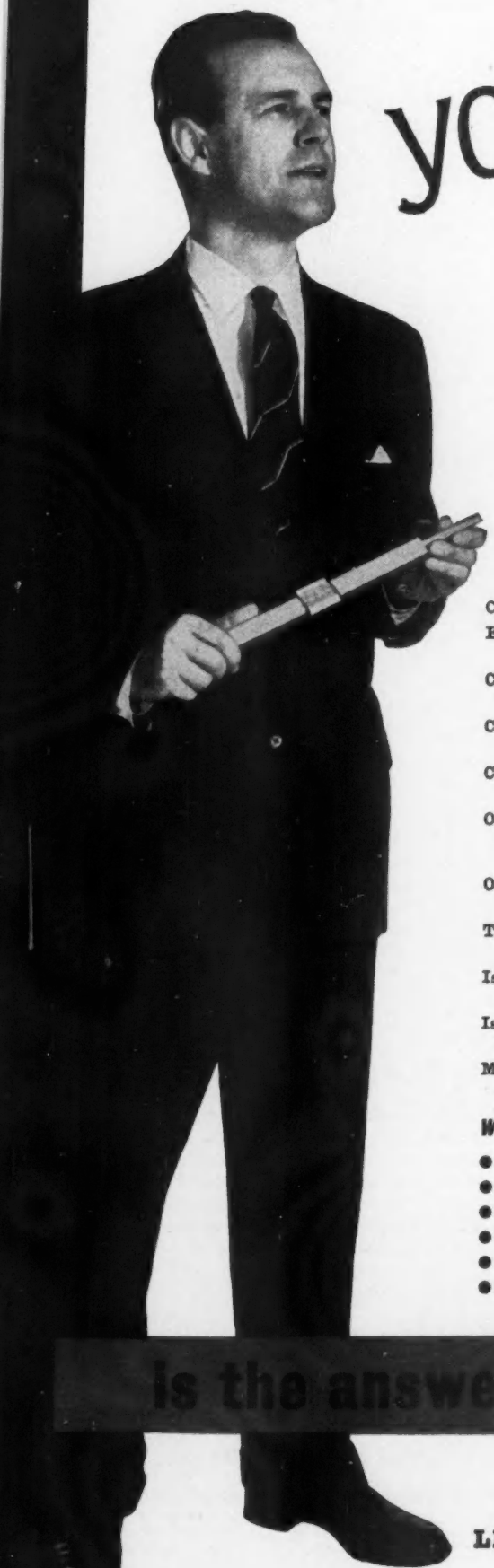
Whichever way you look at it, you'll find that M.T.E. 'double-service' is the answer.

Top left:
Control panel for eight-head rotary indexing machine.

Lower left:
Control panel for industrial refrigeration plant.

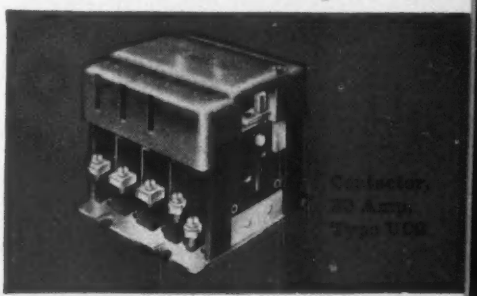
MTE 'DOUBLE-SERVICE'

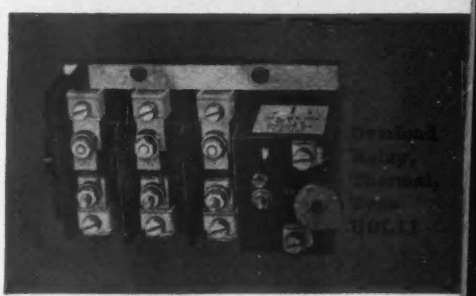
M.T.E. CONTROL GEAR LIMITED

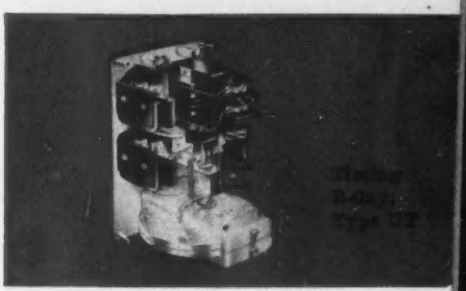


you look at it

COMPONENTS IN DOUBLE-QUICK TIME







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Eight Pole Relays Type UR1	7/9 days
Contactors, 15 Amp, Type UC2L	7/9 days
Contactors, 30 Amp, Type UC2	7/9 days
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Overload Relays, Magnetic	9/11 days
Timing Relays, Type UT	13/21 days
Isolating Switches, 40 Amp, Type UIS02	7/9 days
Isolating Switches, 150 Amp, Type UIS03	9/11 days
Multi-Lock Terminal Blocks, 15, 40 & 100 Amp	1/3 days

With these design features—

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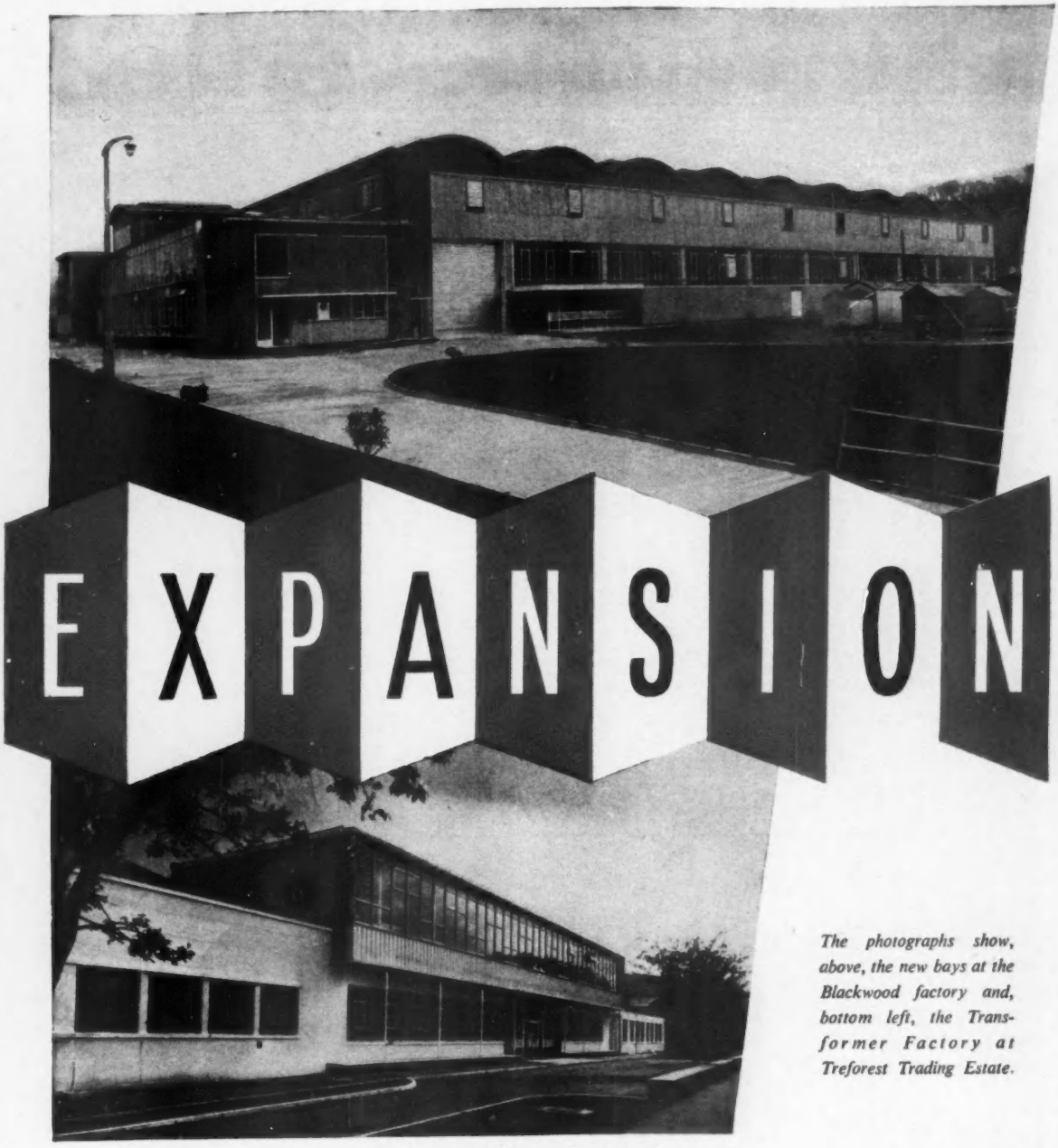

The photographs show, above, the new bays at the Blackwood factory and, bottom left, the Transformer Factory at Treforest Trading Estate.

The success of our research, designs, and manufacturing policy in the field of switchgear is clearly indicated by our continuous expansion and the confidence shown in S.W.S. products throughout the world.
The fact that S.W.S. equipment is repeatedly 'first choice' confirms this confidence and an expanding organisation such as ours needs more space to meet the consequent ever-growing demand for our products. The current building programme includes factory and office extensions, a new research and laboratory block and a new transformer works.

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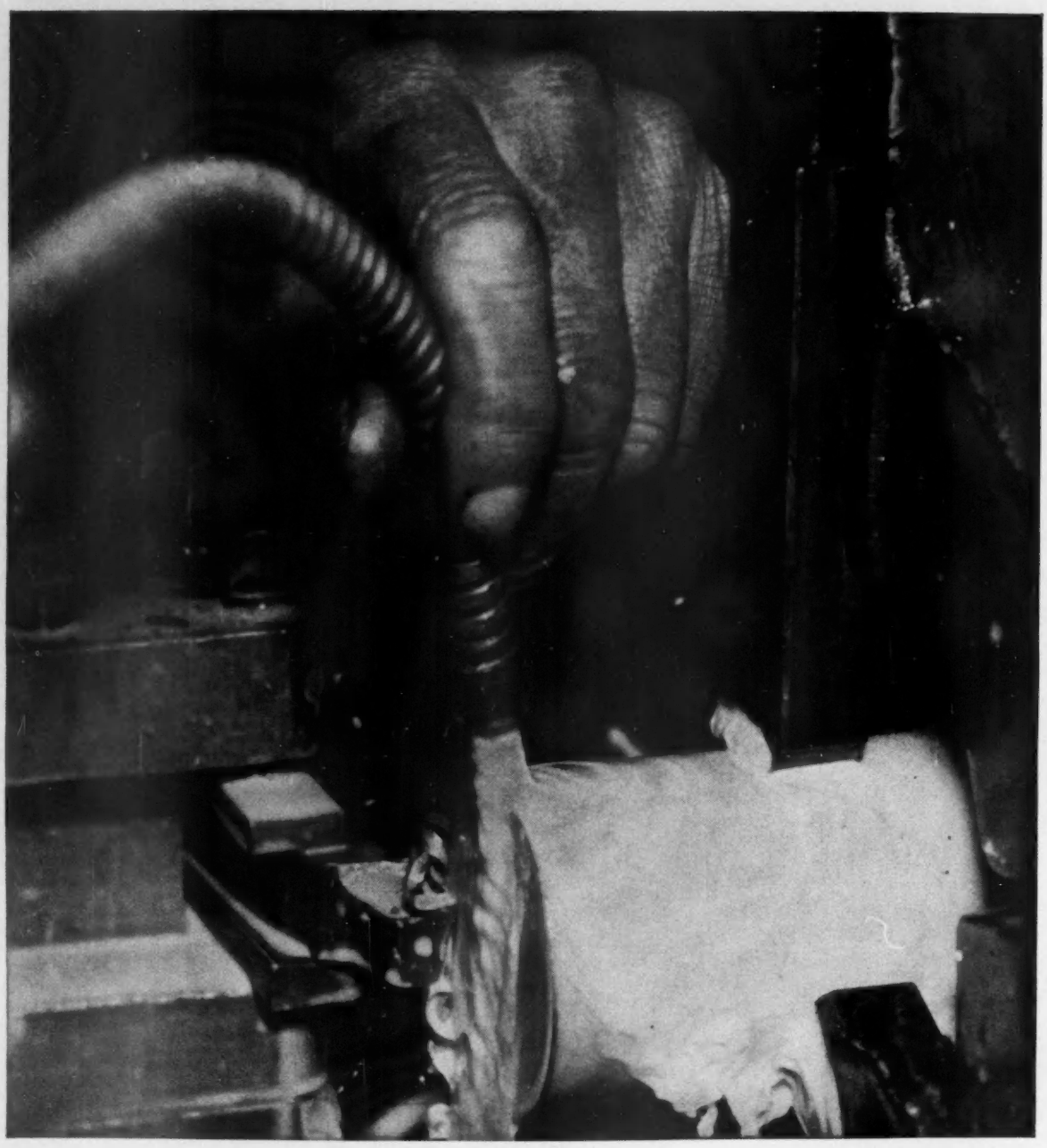
SWITCHGEAR · FUSE-SWITCHGEAR · TRANSFORMERS · CONTROL BOARDS

SW 26

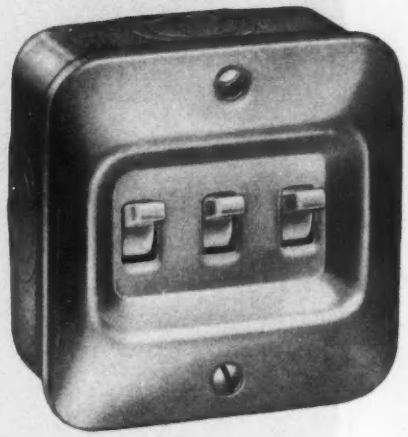
Shell achievement



One of Shell's recent achievements in Industrial Lubrication has been to reduce the risk of skin trouble for machine operators. Until the new Shell Dromus range, most modern soluble cutting oils contained phenolic compounds, which can cause skin irritation. They were used as coupling agents between the actual oil and the emulsifier. On high-speed machines, especially, the water evaporates and the emulsion concentrates. And that's when the trouble can start. Shell scientists found a better coupling agent, and made it work. And now, at no extra cost, management can reduce working risks for their staff. *Write for the book, 'Selecting Your Cutting Oils', to Shell-Mex House, London, W.C.2.*

SHELL

SHELL INDUSTRIAL OILS



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surface switches in steel boxes & covers

- ✱ 3 sizes of box. Deep drawn, Dual knockouts
- ✱ 3 grids
- ✱ 1-12 gang
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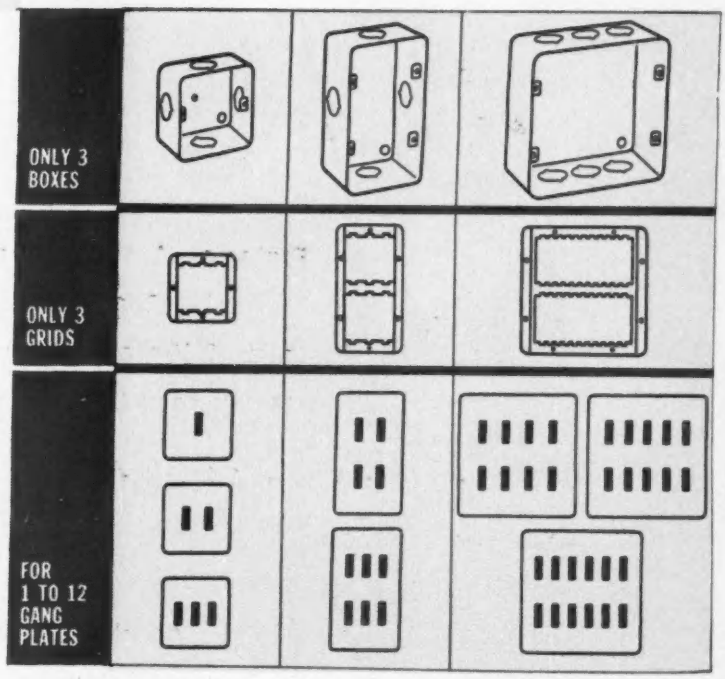
5 amp. 2-way S.P. secret switch
Mains voltage bell push
Neon indicator



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THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, LONDON, W.C.2
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CABLE TRUNKING
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ELECTRIC WIRING ACCESSORIES
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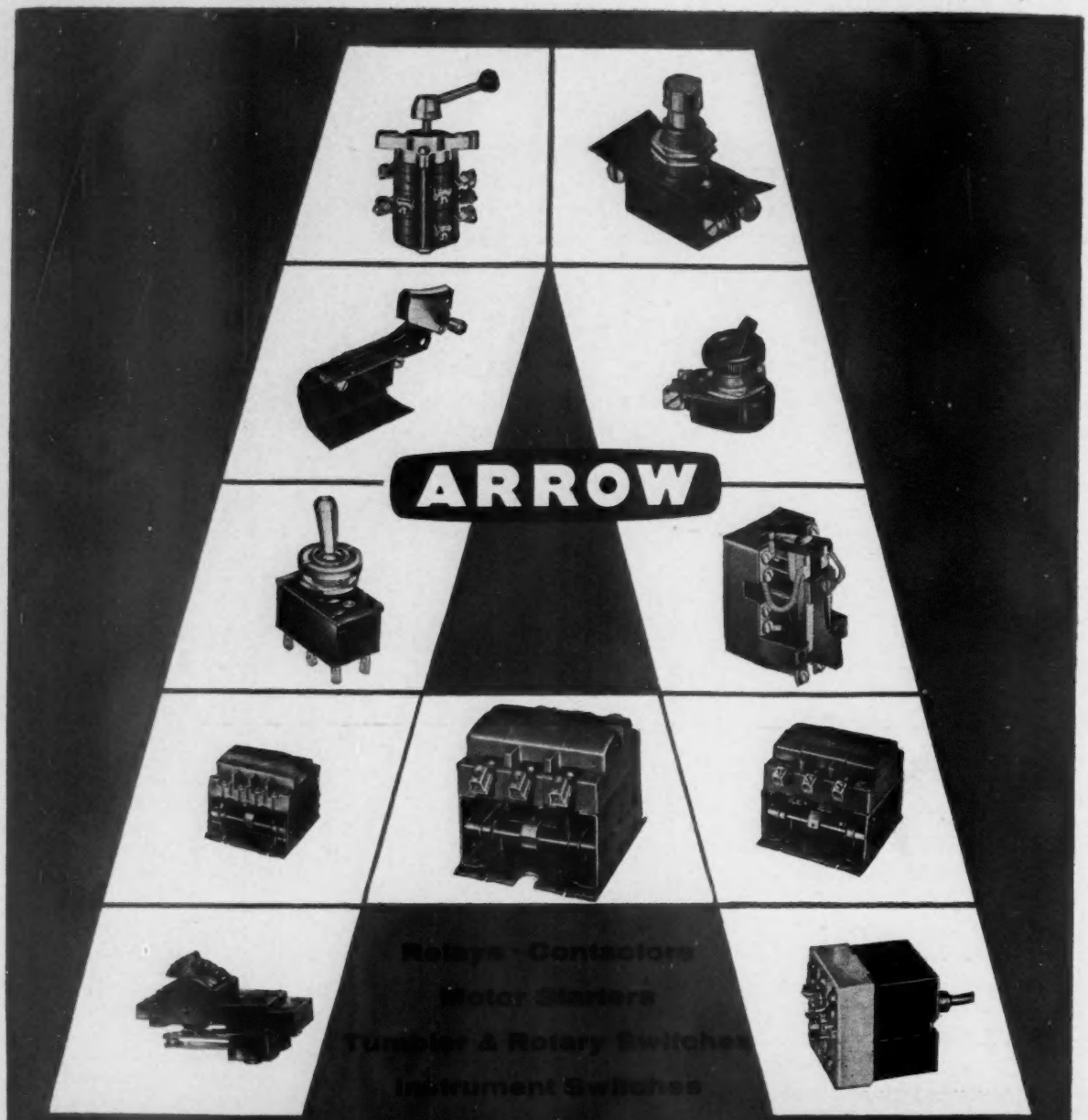

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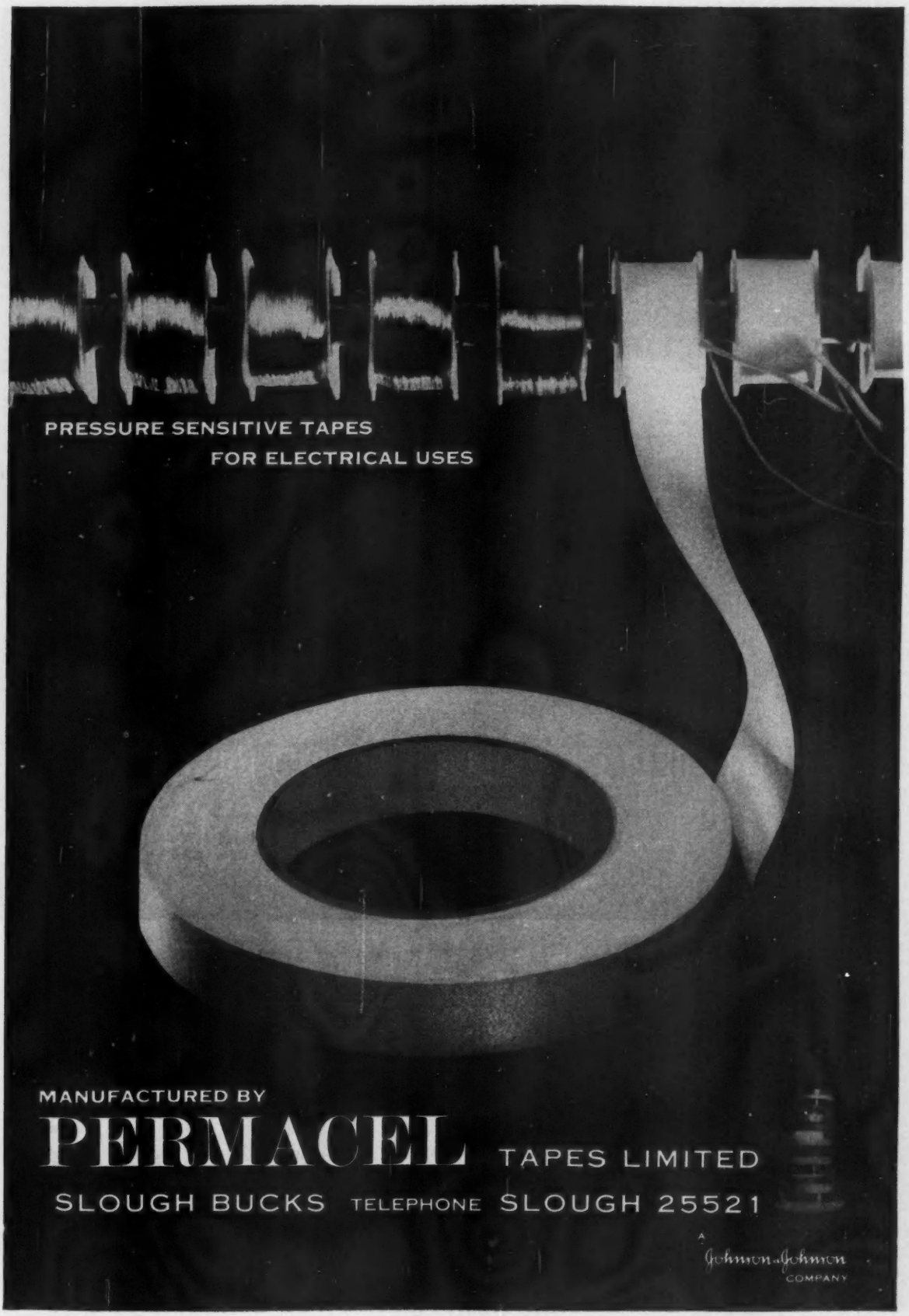
ARROW ELECTRIC SWITCHES LTD. BRENT ROAD SOUTHALL MIDDLESEX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FOR ELECTRICAL USES
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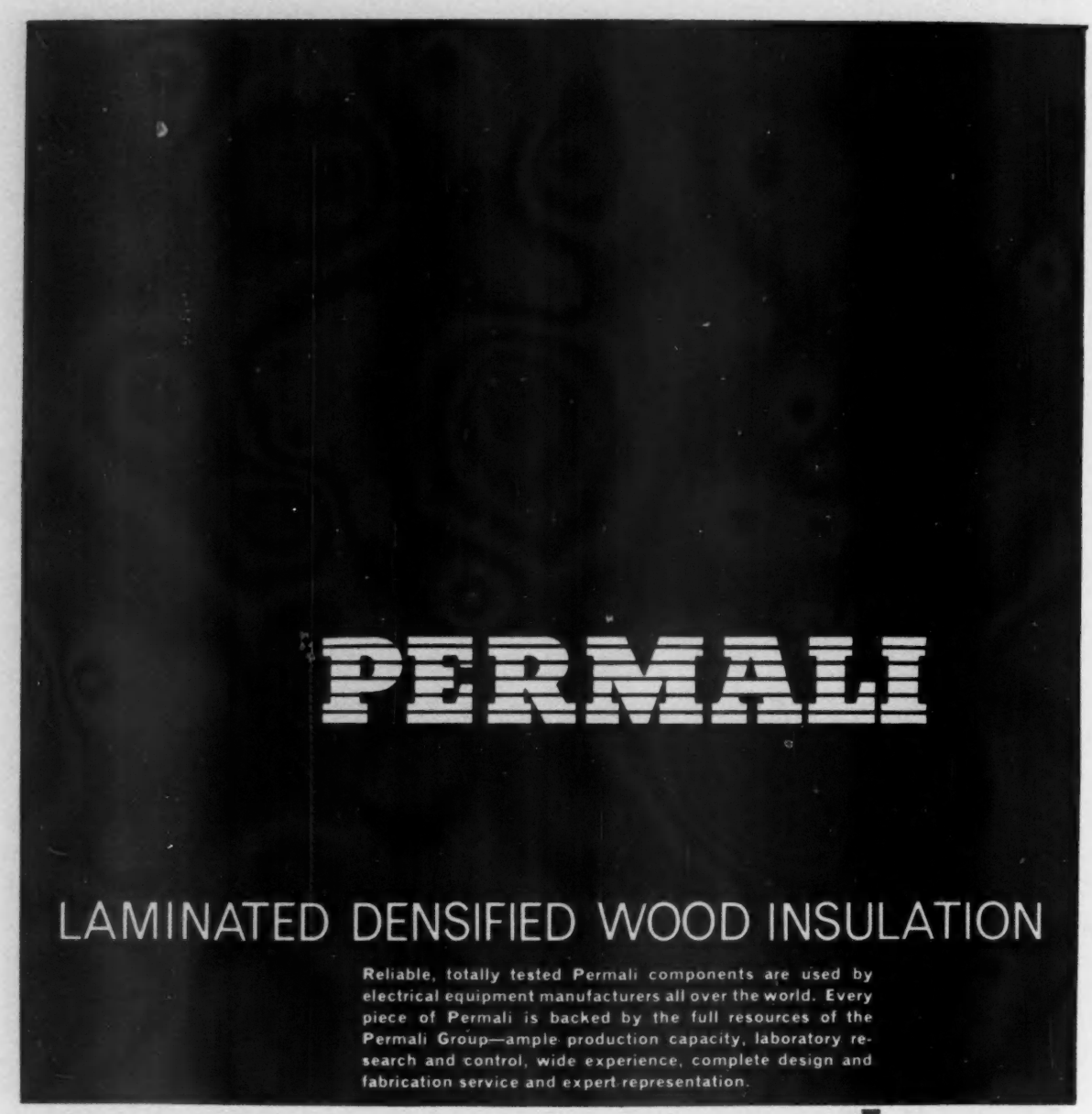

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ELECTRICAL TIMES

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Dans ce numéro

Alternateur excité par redresseur au germanium ... 823
Le courant d'excitation pour un turbo-alternateur de 30 MW est fourni par un alternateur pilote, et redressé par un redresseur au germanium. L'équipement a fonctionné de manière satisfaisante depuis plus d'un an. L'excitation est contrôlée automatiquement par un amplificateur magnétique à deux étages, à réponse rapide, qui règle l'excitation de l'alternateur pilote. Il n'y a ni commutateur ni système de balais sur l'excitateur principal; ce dernier ne comporte que des bagues collectrices avec balais simples.

Traitement des enroulements modernes, 2ème partie 827
Les lubrifiants qui se trouvent présents à l'intérieur des mécanismes d'avions limitent le choix des matériaux d'imprégnation pour les enroulements des générateurs d'électricité emportés dans ces avions. On utilise des matières organiques spéciales à " l'usage individuel ". De nombreux avantages sont présentés par l'usage de caoutchouc de silicone dans les moyennes et grosses machines utilisées en service normal au sol. Toutefois il y a lieu d'examiner avec circonspection ses propriétés mécaniques et de maniabilité qui sont très différentes de celles des matériaux d'isolement conventionnels. La rigidité diélectrique du caoutchouc de silicone, mesurée en volts/mm, baisse très rapidement avec l'accroissement de l'épaisseur.

Cuivre et aluminium pour câbles, 3ème partie ... 838
On peut faire usage de cuivre pour le gainage des câbles à isolement minéral, sous forme de gaine soudée et gaufrée dans un câble basse tension à isolement papier, ayant un conducteur neutre concentrique. Le remplacement des gaines de plomb par d'autres en aluminium n'affecte pas sensiblement l'écoulement de chaleur depuis les câbles, et ne modifie pas la valeur nominale du court-circuit limiteur de tension. Il serait désirable que les normes nationales prévoient avec impartialité l'usage de conducteurs en cuivre ou en aluminium dans les câbles.

In dieser Nummer

Wechselstromerzeuger mit Germaniumgleichrichter-erregung 823
Erregerstrom für einen 30 MW Turbinenwechselstromerzeuger wird von einem Steuergenerator geliefert und mittels Germaniumgleichrichter gleichgerichtet. Die Anlage hat seit mehr als einem Jahr zufriedenstellend gearbeitet. Die Erregung wird automatisch durch einen schnell ansprechenden, zweistufigen magnetischen Verstärker geregelt, der die Erregung des Steuergenerators reguliert. Die Haupterregermaschine benötigt kein Kollektor- und Bürstensystem, sondern arbeitet mit Schleifringen und einfachen Bürsten.

Neuzeitliche Bearbeitung von Wicklungen, Teil 2 ... 827
Die in der Flugzeugatmosphäre enthaltenen Schmiermittel beschränken die Auswahl an Imprägnierstoffen für die Wicklungen elektrischer Stromerzeuger bei Anwendungen dieser Art. Es werden daher speziell für diesen Bedarf zugeschnittene organische Substanzen verwendet. Für mittlere und grosse Maschinen im gewöhnlichen Bodeneinsatz besitzt Silikonkautschuk zahlreiche Vorteile. Es muss jedoch besonderes Augenmerk auf seine mechanischen und bearbeitungsmässigen Eigenschaften gerichtet werden, die von den Eigenschaften herkömmlicher Isolierstoffe stark abweichen. Die Durchschlagsfestigkeit des Silikonkautschuks in Volt pro mm fällt mit zunehmender Dicke sehr stark ab.

Kupfer und Aluminium für elektrische Kabel, Teil 3 ... 838
Die Verwendung von Kupfer für die Kabelumhüllung kommt bei magnesisch isolierten Konstruktionen in Frage, während bei Niederspannungskabeln mit Papierisolierung und konzentrisch angeordnetem Nulleiter Kupfer in Form einer geschweissten, gerieften Umhüllung verwendet werden kann. Die Anwendung von Aluminium- statt Bleimänteln ändert die Wärmeabgabe der Kabel nicht wesentlich und ebensowenig ihre Kurzschlussfestigkeit. Die Einführung nationaler Normen, die Verwendung von Kupfer- oder Aluminiumleitern in Kabeln in unvoreingenommener Weise behandeln, erscheint gegeben.

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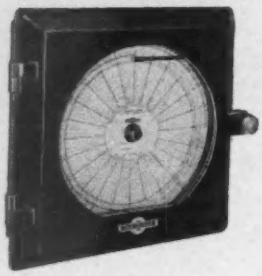

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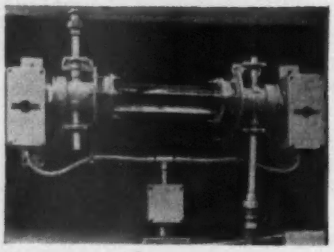

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Comment

BREAKDOWN

Last week's supply breakdown in the south east of England passed off, fortunately, without injury to any member of the public or major damage. That outcome is something to be thankful for, but it softens only a little the severe blow delivered to public confidence in the reliability of electricity supply. That some 1,500 MW of load could be cut off for a period ranging from half an hour to two and a half hours is not to be tolerated. Nor would supply engineers wish it to be. All such incidents have an element of mystery, and it will not be easy to discover why a system that was believed to be "secure" in terms of line capacity from the generating stations in use, in the event, collapsed in a relatively short time. The setting up of a technical committee of inquiry headed by a Board member was the least the CEGB could do, both for their own information and for the assurance of the public. It is to their credit that they did it so promptly. The Board should be equally prompt in publishing the findings of the committee. Further, although the reason for the sequence of fault tripping, low voltage and frequency operation and ultimate rapid collapse of the system will not be easy to make clear to the general public, that end must be resolutely pursued. Even before the technical complexities are unravelled, however, one element stands out and can be appreciated readily. The breakdown was confined to the 132 kV system; the 275 kV lines, which were carrying much of the supply to the area from the Midlands, extend only to the north west extremity of the area. Had the intended 275 kV spur down to Canterbury and beyond not been delayed by planning difficulties, it is doubtful if the incident would have developed to its grave extent. But systems have to be operated with the plant available, and continuity of supply assured on that basis. This is not the first time that sequence tripping on grid lines has resulted in the shut down of supply over a large area. With the dependence of the public on electricity today, better margins of safety must be sought in an attempt to make it the last.

AMERICAN C.B. RATINGS

Much confusion has been caused over the years by differences between one country and another in the short-circuit rating of circuit-breakers. In Britain, a breaker is tested for its ability to break a low power factor circuit, so that for any fairly high speed of operation the current at the instant of break has a considerable degree of asymmetry. Despite this, it is the symmetrical component of the current that is used for the short-circuit rating. In America, on the other hand, the r.m.s.

value of the total current, including the d.c. component, has provided the numerical value for rating purposes. As a result, American breakers have appeared to uninformed overseas buyers to have a breaking capability about one-quarter greater than a British c.b. of equivalent performance. This has proved a serious problem in overseas selling, and much effort has been expended in getting the true situation appreciated. Now it seems that the Americans are likely to fall in line with the British—and the International Electrotechnical Commission—basis of short-circuit rating. They plan to introduce ratings based on a rated symmetrical breaking current at a rated voltage. Some details of the changes, which seem to be at a preliminary stage, are given in a paper to the recent American Power Conference, summarised on a later page. The American estimate is that for a circuit-breaker opening its contacts three cycles after initiation of the short-circuit, asymmetrical current breaking capability will be about 9% up on the present requirements for a given nominal rating, with bigger increases for faster-acting breakers. At the same time, the Americans plan to change the rated voltage to the design voltage rather than system nominal voltage. Nor is that the full extent of the changes. Just what the alteration will mean will be governed also by the exact testing rules that are required to be applied. Overall, however, it seems likely that a disadvantage to British export selling will at least be lessened if the American proposals are carried through.

A.C. EXCITATION

Alternators as exciters for larger synchronous generators have many attractive features compared with d.c. machines. The advent of the semiconductor rectifier has made it practicable to realise these advantages, and the article opposite describes how this is achieved for a 30 MW machine. The outstanding advantage of the method is in terms of maintenance. Slip-rings are greatly preferable to commutators when plant running for many days at a time is concerned. With alternators supplying excitation, only slip-rings are needed and the brush changing associated with these is more easily managed without stopping. The sensitiveness that rectifiers exhibit to overloading and to inverse voltages seems to have caused no trouble, even under test conditions simulating the behaviour of machines in extreme system fault conditions. Since the reliability found with germanium rectifiers is unlikely to be less with silicon cells, which are now coming into use for the same purpose, the outlook for this excitation technique is set-fair. Indeed, only recently we noted how it could make possible the use of techniques such as third harmonic excitation. The development that remains attractive for the future is the use of rotating rectifiers, with the main exciter an inverted machine having a rotating armature, and shaft connections between it and the main machine rotor to eliminate all need for slip-rings. Such a possibility seems mainly a question of rectifier size and ruggedness once the overall idea of a.c. excitation is proved.

INSTRUMENTING AVAILABILITY

The latest of the sombre-coloured bulletins of the Boiler Availability Committee falls outside the usual scope of those useful publications. It deals with measurement techniques to determine flue gas properties rather than the anatomy or direct prevention of the deposits and corrosive agents which reduce efficiency of water-tube boilers. But the new Bulletin No. 11 is no less welcome for that. Instrumentation has been a constant concern for the Committee in its researches, and several techniques have been evolved capable of use in stations. Most of those described in the present work are intended to give a relatively rapid answer to an important question: whether flue gases are likely to give more or less trouble from the corrosion and deposit aspect than those resulting from some other fuel or other method of operating the boiler concerned. To have techniques for varied situations compactly described invites the making of measurements, which is always welcome as a step towards developing efficiency scientifically. Further than that, the knowledge that a relatively reliable check can be obtained on the corrosion and fouling tendencies of a particular method of operation encourages experiment in that respect. It is welcome that the Committee are seeking to make the testing still more convenient. A statement issued at the same time as the Bulletin notes that a considerable effort is being made to substitute automatic recording instruments for the hand-operated equipment involved in the techniques described.

SMOKELESS FUEL OPPORTUNITY

Smoke control areas established under the Clean Air Act have provided a fine opportunity for selling electric heating. Limitation on the use of open fires, which applies in such areas, provides an incentive to try electric heating. Once its convenience is experienced and initial worries about cost disproved by experience, regular use is likely to follow. How far this effect has operated is likely to show in the survey being carried out by the Central Office of Information on domestic fuel used in some 60 smoke control areas in England and Scotland. Even more incentive to use electricity in smoke control areas is provided by the limitation on choice of fuels suitable for open fires which is appearing. The Minister of Power confessed in a Parliamentary answer last week that in some areas open fire smokeless fuels are going to become in short supply as time goes on. Coke for closed stoves will be available, but that is a very different matter from the aspect of the housewife. Electricity can meet all the requirements of the Clean Air Act without any of the complications solid fuel methods seem to involve.

Meteor

This week's quick summary of electrical news faces advertisement page 8

Turbo-alternator field rectifiers

USE OF GERMANIUM CELLS

by J. J. Arnold, B.Sc.(Eng.)

THE ultimate goal of the turbo-generator engineer must be to design a machine that can be kept running for a few years before it needs to be shut down for inspection and maintenance. Routine maintenance should not involve shutting down at frequent intervals, since a short time at standstill requires many hours of operation at reduced load, slow turning to ensure uniform cooling of the turbine and also associated difficulties with the unit boiler auxiliaries. For economical operation, therefore, a modern turbo-generator must run at or near rated load continuously for as long as possible.

Thus, items of maintenance such as changing brushes and cleaning commutators, previously relatively minor operations, now assume importance if they involve shutting down the set. Changing brushes on load is a delicate operation, particularly on d.c. machines, where some brush-arms are necessarily underneath the commutator, and may be difficult of access.

The scheme described in this article avoids exciter commutators and their associated brushgear. Generator and main exciter slip-rings and brushgear are retained, but brush-changing on load is not so difficult, as brushes are usually grouped over the top half of the slip-rings.

A.C. exciters are used, the outputs of which are rectified and supply the main exciter and generator fields. Germanium rectifiers are used, and a further object of the scheme is to demonstrate the reliability and suitability of semiconductor rectifiers for central station use. This use of rectifiers for producing direct current for the excitation of synchronous machines is not a new idea, but it is believed that this scheme is the first in this country to use semiconductor rectifiers for exciting a generator supplying the National Grid system.

A new two-stage magnetic-amplifier voltage regulator was developed to operate with the a.c. exciters, and its performance and reliability have been demonstrated.

The equipment has been operating for well over a year with one of six standard 30 MW turbo-generators in the CEGB Eastern Division's generating station at Goldington.

Description of Scheme

In the following description of the scheme, the numbers in brackets refer to item numbers in the simplified schematic diagram, Fig. 3.

Isolating switch (1) enables the automatic voltage regulator to be switched out of circuit and the excitation controlled by hand. In this condition the output from the three-phase a.c. pilot exciter (2) is fed to an induction regulator (3), for hand variation of pilot exciter voltage.

The output from the induction regulator is fed to a three-phase full-wave rectifier bridge (4), and the rectified current is supplied to the field of the a.c. main exciter (5) through slip-rings. The main exciter output is rectified by the main three-phase full-wave rectifier bridge circuit (6), and supplied to the field of the main generator (7) through slip-rings The reactances of the generator circuits are large,

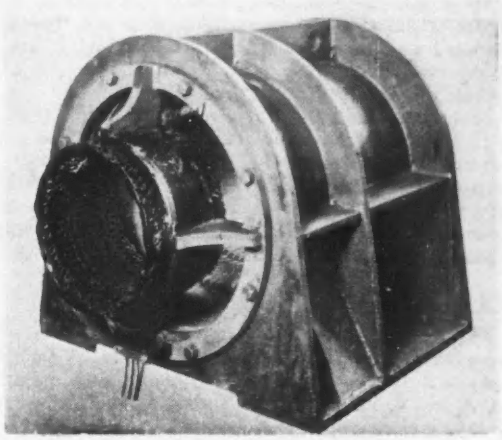


Fig. 1. Field system of the main and pilot exciters for a germanium rectifier excitation system for a 30 MW turbo-alternator

so that additional smoothing apparatus is not necessary. A quick-acting make-before-break field-suppression switch (8) suppresses the fields of the main generator and exciter under fault conditions.

It will be seen that operation on hand control is similar to the orthodox system using two d.c. exciters, the induction regulator taking the place of the usual field rheostat.

With the voltage regulator in service, the main generator voltage, taken from voltage transformer (9), is compared with a standard in the voltage sensitive circuit (10) and a difference current taken to the first stage magnetic amplifier (11). The output current from the first stage controls the second stage magnetic amplifier (12).

The a.c. pilot exciter output feeds into the second stage amplifier. The controlled output of the second stage amplifier is rectified by the rectifier bridge (13) and supplies the main exciter field.

A rise in generator terminal volts above normal causes the amplifiers to react so as to reduce the main exciter field current and hence the main generator excitation, so reducing the terminal volts to the nominal value. Various forms of compounding can be incorporated. For example, Fig. 3 shows a conventional quadrature droop compounding circuit operating from current transformer (14), which ensures the satisfactory sharing of reactive kVA between generators when two or more are operating in parallel.

When the regulator is on automatic control, a follow-up unit automatically adjusts induction regulator (3), so that if the voltage regulator trips or is switched out of circuit, the induction regulator would be in the correct position to supply the same excitation current as obtained on automatic control and the changeover would be smooth.

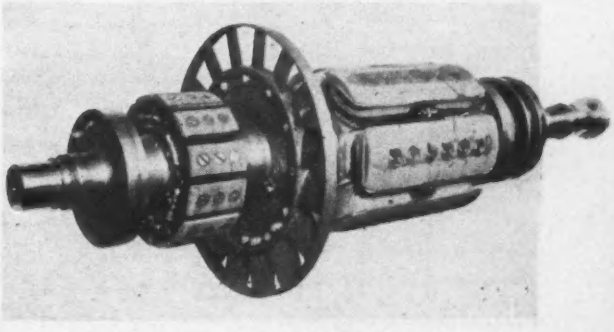


Fig. 2. The twin pilot and main exciter rotors

When changing from hand to automatic control, voltage control rheostat (15) is adjusted until a zero reading is obtained on the excitation balance meter (16). Turning changeover switch (17) then causes contactors (18, 19) to operate and transfer control smoothly.

Protective relay (20), removes the voltage regulator from service if a sustained over-voltage or v.t. fuse failure occurs. A reactive load-limiting circuit prevents the excitation being reduced below a safe level, which allows load swings to occur at leading power factors without instability occurring. All auxiliary supplies for the voltage regulator, relays, etc., are obtained from the pilot exciter.

A.C. Exciters

The full-load excitation requirement of the main generator is 93 kW, i.e., 380 A, at 245 V. The excitation equipment has a continuous maximum rated output of 500 A, 350 V, 175 kW, with a 1 minute field-forcing rating of 35% greater amps and volts, or 82% greater kW.

The main exciter is a three-phase salient-pole a.c. generator, continuously rated at 195 kVA, 275 V, 410 A, 0·93 power factor lagging, 150 c/s. The exciter has 6 poles, and the rotor is driven directly from the main generator through a flexible coupling at 3,000 r.p.m. The frequency of 150 c/s was chosen because the 6-pole generator appeared to be the most practical design. The power factor derives from the rectifier characteristics and the exciter leakage reactance, which is approximately 25%.

The pilot exciter is a three-phase, permanent-magnet, salient-pole a.c. generator, continuously rated at 6·3 kVA, 230 V, 15·8 A, 0·5 power factor lagging, 300 c/s. There are 12 poles on this machine with the permanent magnet portions made of Alcomax III, and wound with a field winding to enable them to be remagnetised at standstill from a battery should this be necessary. The low power factor is required because of the inductive load imposed by the magnetic amplifier windings on auto control.

Both exciters are housed together in a common frame structure which is shown in Fig. 1. The two rotors are mounted together on one shaft, running in its own twin bearings. Fig. 2 shows the rotors, with the main exciter slip-rings at the far end. The axial fan draws air from the machine foundations through a filter, passes it through the two exciters and then returns it to the basement. Some air is diverted to ventilate the main generator slip-rings.

Rectifiers and Induction Regulator

The main excitation rectifiers are housed in the cubicle shown in Fig. 7. There are two side compartments, as illustrated, each containing a full-wave, three-phase bridge circuit with the full rating of 500 A, 350 V, and an overload capability of 680 A, 475 V for one minute. Normally, the two circuits operate in parallel, but either may be isolated for maintenance or inspection while the other carries the load.

Each of the six arms of the bridge is divided into four parallel circuits containing five germanium rectifier cells in series with an 80 A h.r.c. fuse. Thus, there are 120 rectifiers per bridge, and 240 altogether. The nominal rectifier cell rating is 50 A, 150 peak inverse volts at 30°C ambient. Each cell is mounted on a trough-shaped extruded section aluminium cooling fin. The connections are taken from the a.c. busbar, through the fuse to the first rectifier terminal, from the first rectifier fin to the second rectifier terminal, and so on to the d.c. busbar.

Each of the six a.c. input connections is divided into two parallel circuits, fitted with current transformers connected so that a relay operates if the current through one half-arm exceeds that through the other, e.g., as would happen if one of the rectifiers open-circuited or a fuse ruptured. The normally closed contacts of these six relays, together with contacts on the fan motor starter are connected in series and operate an alarm if any one contact opens.

The a.c. and d.c. isolators are mechanically interlocked, so that only one bridge circuit can be isolated at once, thus ensuring continuity of supply as far as possible.

Two motor-driven fans, in series, are mounted in the bottom compartment and draw air through the screen at the top of the left-hand rectifier compartment, over the rectifiers, through the fans and out through the right-hand rectifier compartment.

Star-connected capacitors of 10 μfd, each protected by a 20 A fuse, provide hole-storage capacitance for the rectifiers. A d.c. voltmeter and two d.c. ammeters, one for each bridge, in the front door, complete the cubicle.

The three-phase motor-operated induction regulator

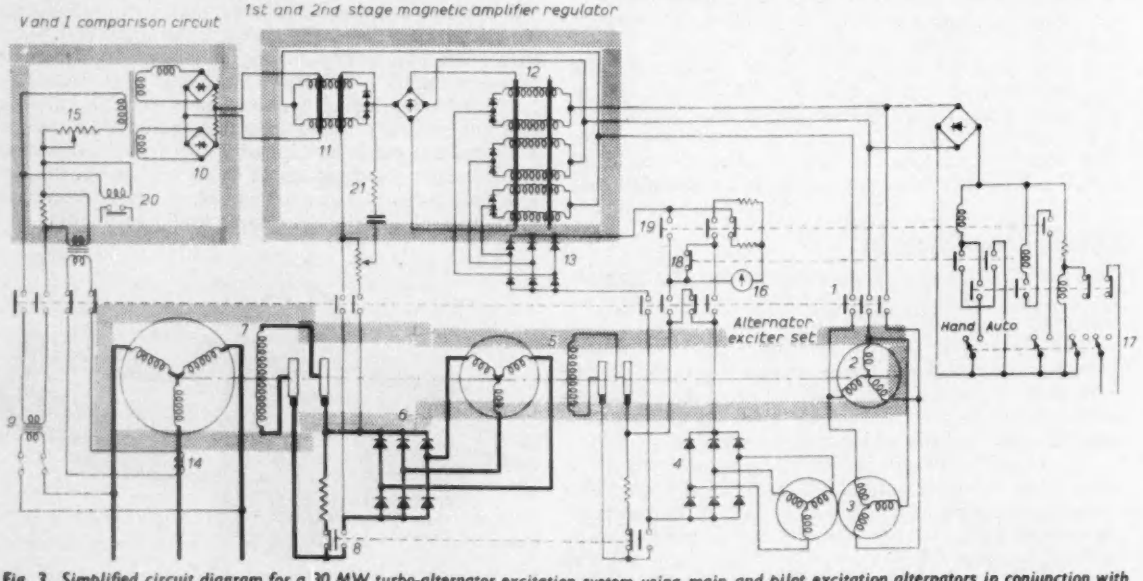


Fig. 3. Simplified circuit diagram for a 30 MW turbo-alternator excitation system using main and pilot excitation alternators in conjunction with germanium rectifiers. The alternator output is controlled by a two-stage magnetic amplifier acting on the pilot exciter alternator field

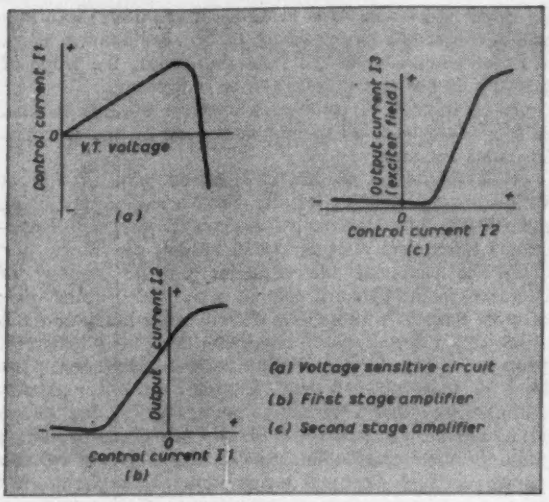


Fig. 4. Characteristics of the magnetic-amplifier used in the voltage regulator for a 30 MW turbo-alternator

receives its input from the a.c. pilot exciter at 230 V, 300 c/s. Its output is continuously variable from zero to 55 V, the continuous rated current being 17·5 A.

A split-field series d.c. motor can rotate the induction regulator rotor through 180°, i.e., from zero to maximum voltage, in 45 sec.

The regulator output voltage is fed to a 2:1 step-up transformer, and thence to the rectifier bridge supplying the main exciter field.

Automatic Voltage Regulator

In the voltage-sensitive circuit, the reference element consists of a saturable reactor which gives a substantially constant output current through a rectifier, irrespective of wide variations in input voltage. A current proportional to the input voltage is compared with this reference current and any difference current is fed into the control winding of the first-stage magnetic amplifier. This difference current has a characteristic as shown at (a) in Fig. 4.

The first-stage magnetic amplifier is of the conventional, single-phase auto-excited type, taking its supply at 300 c/s from the pilot exciter. An adjustable negative feedback is derived from the main generator rotor voltage through a resistance-capacitance network and fed into an auxiliary control winding on the amplifier. This feedback stabilises the regulator and prevents hunting or serious overshoot. Fig. 4(b) shows the first-stage amplifier characteristic.

The output from the first-stage amplifier is fed into the control winding of the second stage. This is a three-phase auto-excited magnetic amplifier, drawing its supply from the pilot exciter. The amplifier incorporates an auxiliary bias winding and its characteristic is shown at (c) in Fig. 4. The second stage amplifier output is rectified and fed to the field winding of the main a.c. exciter. The gain and feedback controls are set to give the best compromise between gain and speed of response.

It will be seen from Fig. 5 that a change in generator voltage of 1% is sufficient to change the amplifier output current flowing through the field of the a.c. exciter from the value required with the main generator on no-load to that required at full-load. Changes in voltage greater than 2½% cause the reactors to saturate and apply maximum field for forcing.

The voltage regulator is housed in a floor-mounted sheet steel cubicle which includes a local isolating switch and monitoring meter to enable various internal currents to be checked. The external controls, normally mounted on the generator control desk, comprise a "hand-auto" change-over switch, "hand" and "auto" excitation adjusting switches, and an excitation balance meter for use when changing from hand to automatic control.

Results of Factory Tests

The equipment was tested as far as possible in the factory before installation at site, but because of the difficulty of applying appreciable load to the generator, all tests were made with the generator on open-circuit.

Sudden changes in generator load produced changes in terminal voltage, and these changes were simulated by sudden insertion or removal of resistance in the voltage-sensitive circuit of the regulator, thereby causing sudden changes in the controlled voltage. Oscillograms were taken showing the transient effects of these changes on the operation of the generator and main exciter.

The oscillogram, Fig. 6, shows the effect produced by sudden changes in the voltage reference circuit corresponding to a 10% increase and decrease in the main generator voltage. The following traces are shown:

(1, 4) Generator voltage from voltage transformer secondary (rectified, smoothed and backed off).

(2, 5) Generator field (rotor voltage).

(3, 6) A.C. main exciter field voltage (i.e., the rectified output from the voltage regulator).

Timing scale (impulses 0·1 sec apart).

The regulator damping was adjusted to give a small amount of overshoot on the generator voltage. The effect of load on the generator would be to decrease this overshoot somewhat, but the response time would be only slightly affected. It should be noted that a change in voltage of 10% causes the amplifiers to saturate so that maximum field forcing is applied.

Trace 3 shows the effect of the reference change on the regulator output. This rises very rapidly at first and is then reduced as the main exciter output voltage starts to rise and causes the feedback to become effective. The generator rotor voltage (trace 2) rises to a maximum and exhibits some oscillation, following the regulator output, but considerably damped due to the largely reactive circuit.

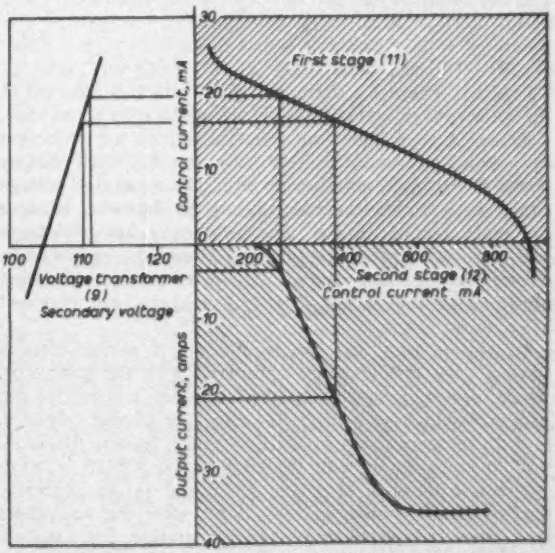
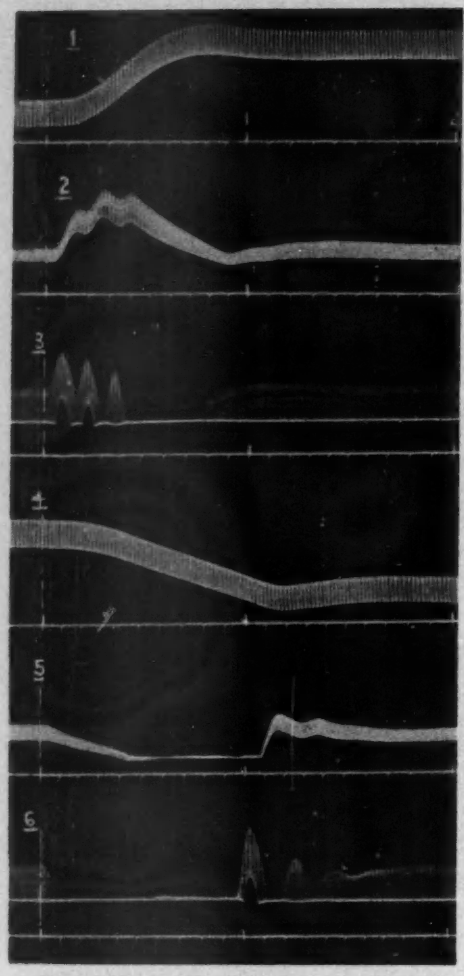


Fig. 5. Characteristics of the magnetic-amplifier voltage regulator showing output current as a function of voltage transformer secondary voltage. The output current energises the main exciter rotor



1. Alternator stator voltage 1 cm: 10% V

2. Alternator rotor voltage 1 cm: 240 V

3. Exciter alternator field voltage 1 cm: 240 V

4. Alternator stator voltage 1 cm: 10% V

5. Alternator rotor voltage 1 cm: 240 V

6. Exciter alternator field voltage 1 cm: 240 V

Fig. 6. Effect of 10% sudden change in voltage reference circuit

The oscillation is damped out after about three cycles and is not detrimental to the performance of the system. The generator voltage (trace 1) begins to increase after a delay of 0·1-0·15 sec, and rises at a maximum rate of 2·5 kV/sec. There is a slight overshoot, which is reflected in the rotor voltage, and the new value steadies after about 1 sec.

Traces 4 to 6 show the same quantities for reduction in voltage reference. In this case, the regulator output (trace 6) is rapidly reduced to zero. The generator voltage (trace 4) is slower to reduce than to increase, because the main rectifier bridge acts as a very low resistance path across the rotor winding and allows the excess rotor current to circulate round this path instead of being absorbed in the exciter. Steady conditions are obtained after about 1·4 sec.

It will be seen that the regulator and exciter circuits have a very fast response compared with the generator, hence further increase in speed of response in regulator and exciter would have a negligible effect on overall response.

With the permission of the Controller, Eastern Division, and in conjunction with the staff of the CEGB, a comprehensive series of tests was performed on the generator and excitation system in May, 1960, after the equipment had been in normal commercial operation for approximately two years with no reported troubles or difficulties in operation. These tests were designed to subject the equipment to a wide range of abnormal conditions, and the opportunity was taken to obtain much useful information not directly connected with the a.c. excitation scheme.

A full discussion of the results is outside the scope of this article, but a few notes are in order:

Only one bank of rectifiers was in use during the tests, as this was considered to be a fairer test on the rectifiers. The tests included:

(1) Response to sudden changes on no-load and at various loads, including leading reactive loads approaching the stability limit, and tap-changing. These tests demonstrated the system response under various conditions.

(2) The effect of the regulator on the stability of operation in the dynamic stability zone, with a rotor angle of more than 90°. These tests demonstrated that a continuously acting high-response regulator enables a generator to be run much nearer to the limit of stability when supplying reactive power than a "dead-band" regulator. Alternatively, that a reduction in generator short-circuit ratio and size is possible. Pole-slipping occurred during some of these tests, inducing very high inverse voltages on the rectifiers. No breakdowns occurred, despite the fact that no special precautions were taken to divert or suppress the surge voltages.

(3) Asynchronous running, which imposed large currents in the rectifiers.

(4) Sudden three-phase short-circuit from full load, followed by clearance of the fault. Heavy currents were imposed on the rectifiers. This test demonstrated the ability of the regulator to restore stable conditions after a fault.

The tests demonstrated quite convincingly the superior performance of a modern high-speed continuously acting voltage regulator compared with other types of regulator, and also the complete reliability of the a.c. excitation system using semiconductor rectifiers.

The author wishes to thank the manager, AEI turbine-generator division, for permission to publish this paper. Fig. 7 is reproduced by kind permission of W. N. C. Clinch, O.B.E., M.I.E.E., F.INST.P., Controller, Eastern Division, CEGB.

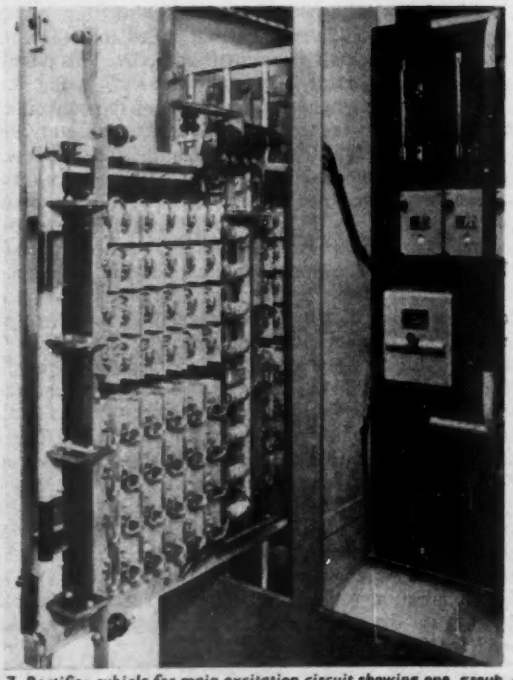


Fig. 7. Rectifier cubicle for main excitation circuit showing one group of the rectifier cells withdrawn

Modern winding treatments

PART 2—AIRCRAFT MACHINES AND SILICONE ELASTOMERS

by W. H. Parriss, B.Sc., A.R.I.C.

IN the first part* of this article, two recent developments in winding treatment for motors were discussed, varnish impregnation of small machines on a continuous production basis and the use of epoxy resin sealed windings in small machines. The present concluding part deals with special processes to meet the requirements of rotating machines for aircraft and with the use of silicone elastomers in providing a sealed winding for medium and large machines.

Aircraft Applications

The operating conditions that obtain in aircraft are more exacting, and special treatments are often necessary. Since it is so important to obtain the maximum power from a given size of machine, there is a constant demand in aircraft applications for insulation materials which will withstand higher and higher temperatures. It might appear at first sight that all aircraft motors and generators should at least possess the conventional Class H construction, involving double glass-covered conductors, silicone-bonded mica slot insulation and silicone varnish impregnation. Some use is made of this system, but more often than not, as far as modern aircraft generators are concerned, the atmosphere in which they operate is contaminated with ester-based lubricants. These behave as powerful solvents and soften most insulation varnishes. Silicones suffer so badly that they are rendered unsuitable for use for this type of application.

While the electrical, thermal and solvent resistance properties of p.t.f.e. are all excellent, only limited commercial use has been made of p.t.f.e.-insulated machines in aircraft, because this polymer is mechanically weak and subject to cut-through under the high centrifugal forces involved. Further, problems in bonding a p.t.f.e. winding together, due to its "non-stick" properties add to the difficulties of its use.

Since completely inorganic systems are still some way off, it is still necessary to rely on organic materials, and these are often tailor-made for each particular application. The three most important insulations in a machine are the slot insulation, the conductor insulation and the impregnating material, and it is vital, therefore, that these three should be compatible so that the thermal endurance characteristics of the system as a whole are better, rather than inferior, to those of the separate components.[6] It is only too easy to arrive at a system which may be excellent from the point of view of high temperature bond strength, solvent resistance and electrical properties, only to find on thermal ageing that the combination has a much shorter life than was indicated by those of the components separately.

One useful combination involves silicone-bonded, glass-backed micanite as the slot insulation, glass-braided conductors bonded with a polyester-type varnish, and an epoxy resin varnish. The silicone bond in the micanite is completely protected from attack by the epoxy varnish. An example of a salient pole generator armature wound and treated in this way is given in Fig. 5. This type of treatment involves a solvent-bearing epoxy resin with a hardener selected to give high bond strength coupled with long life at temperatures in the region of 200°C. In order to achieve a good degree of void filling and a high build, the solvent content is small and mineral fillers are added to impart a degree of thixotropy† to the varnish. This makes impregnation more difficult and it is necessary to use a combination of vacuum and pressure cycles to achieve the desired result.

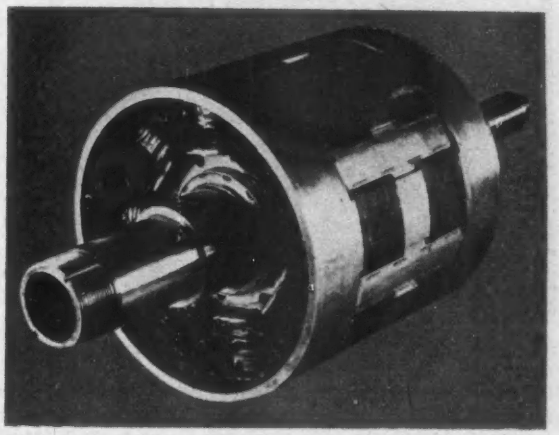


Fig. 5. Salient pole rotor of an aircraft generator, epoxy bonded and suitable for operation at 230°C

A treatment of this nature would involve the following sequence of operations:

1. A short preheat at about 100°C.
2. Vacuum and pressure impregnation with a thixotropic solvent-bearing epoxy resin varnish.
3. Draining and cleaning.
4. Baking at 100°C for four hours, followed by 12 hr at 200°C.

These special epoxy resin varnishes possess a short pot life of a few days only, and it is usual for them to be made up in the treatment area as required. Before each new batch of varnish is used it is necessary to obtain test approval, and again, in view of its short life, special inspection and test facilities may be necessary to achieve this. Further, the short pot life makes such varnishes unsuitable for transferring from a storage tank through pipes and valves to an impregnating vessel, as there is a

* Mr Parriss is with the Research Laboratory, AEI (Rugby) Ltd. Part 1 of the article appeared on 11 May.

† Thixotropy is the property some materials have, of changing from gel to liquid when shaken, but reforming when allowed to stand.

Fig. 6. Filling the spaces in the end windings of a 24,000 r.p.m. aircraft generator rotor with epoxy filling compound

danger that gelation will occur, so that prolonged and difficult cleaning operations will be necessary. It is suggested that each type of machine which is to be impregnated should have its own special impregnating container, which can be made as small as possible in order to cut down on the amount of varnish required. This should, however, have adequate height to allow for bubbling. The heated stator is then placed in its container with the appropriate amount of varnish so that the windings are covered, and the container in turn is placed in a vacuum-pressure vessel and a vacuum drawn over it, followed by the application of pressure. The pressure may vary according to the machine involved; for instance, for the salient pole rotor illustrated in Fig. 5, 40 lb/sq in. was adequate and it is seldom necessary to exceed this.

Occasionally, particularly difficult problems arise where much more reinforcement of windings is necessary than can be achieved by a varnish impregnation. Such a case occurs with a generator shown in Fig. 6, which is designed to run at 24,000 r.p.m. at 200°C. In this example it was impossible to prevent displacement of windings under these conditions by conventional varnishing and banding techniques, even when the windings were completely enclosed in a steel end-bell. But here again, an epoxy resin was readily formulated which was resistant to ester lubricants at 200°C, had a heat distortion temperature in excess of 200°C, a good life at this temperature, and which could be applied in the form of a solventless, unfilled varnish for bonding purposes, and in the heavily mineral-loaded form as a filling compound. Thus, the windings were impregnated with the solventless epoxy resin varnish and then the special compound was applied by hand as shown in Fig. 6, so that all the spaces in the end windings were completely filled. The steel end-bells were then forced over the end windings before the compound had time to set. In addition, the slot portion of the windings was impregnated under vacuum and pressure with the solventless liquid epoxy resin in such a way that drainage was completely eliminated. The effect of this type of treatment was to embed the whole of the winding in a rigid insulation material, leaving no free space into which a conductor could be displaced.

Silicone Rubber-insulated Machines

One of the most important developments in the insulation of medium and large machine windings lies in the use of silicone rubber. This is a material which has excellent thermal endurance characteristics (Class H), is substantially impervious to moisture, and has very good electrical properties. These are the important properties required for machine insulation. However, its mechanical and handling properties are so different from conventional machine insulation that new methods of application have had to be devised.

Unsupported Tapes

One method uses unsupported tape, that is, one without any woven glass or other fibrous reinforcement. The strongest unsupported tapes are those which are fully cured, but these require the application of a separate layer of adhesive during taping in order to produce a completely bonded insulation covering. Other forms of tape are made with a self-adhesive surface, but the full strength of the rubber is only achieved after curing. A tape with a triangular cross-section is preferred, so that the "step" produced by normal rectangular tapes is eliminated and the minimum of voids is obtained. The method is applicable to form-wound stator coils. The conductor group is first consolidated and a primer is applied, which may be of the catalysed silicone varnish or paste type, and which may be formulated to set in an hour or so at room temperature. Special attention has to be paid to insulating the leads where they emerge from the coil, and this may be achieved by the use of a hot or cold curing silicone rubber paste. The coil is taped, using a triangular self-adhesive tape. It is useful if the tape has a guide line along its centre to help in positioning it accurately. While a measure of self-adhesion is desirable, this should not develop too quickly, otherwise it may be impossible to re-position displaced tapes. It is essential, however, that the tape should develop a high bond strength during the subsequent vulcanising process. In order to obtain the minimum of joints the tape is applied as a single half-lapped layer. The thickness of the tape coupled with the winding tension controls the build of the finished insulation. It is necessary, therefore, to obtain the appropriate thickness of tape for each machine and to apply an even and controlled tension during winding.

Finally, a finishing tape is applied. This is usually silicone elastomer coated glass where a Class H machine is involved, but where a lower temperature rating such as Class F is being catered for, silicone elastomer coated Terylene is preferred. It is necessary that this tape should bond to the rubber underneath, and this may be achieved by using a silicone adhesive or by using a tape in which the silicone elastomer has self-bonding properties.

The slot portion of the coil is evenly pressed on all four sides at 150°C. The press time could be as little as five minutes once 150°C has been attained, but this may vary somewhat depending on the vulcanising characteristics of the rubber. Some consolidation of the end winding portion may be obtained by the use of a heat shrinkable tape applied over this region. An example of this type of tape is one made from Melinex which has been stretched while hot and then cooled with the tension still applied. On reheating, this Melinex shrinks and if it has been wound on to an insulated coil, pressure is applied to the insulation as the Melinex contracts. In order to minimise cut-through and contraction of the insulation at the corners of the conductors, temporary metal plates or corner pieces can be used under the heat shrinkable tape to help distribute the pressure.

The coils are then post-cured out of the press in a well-ventilated oven. The silicone rubber insulation should not be allowed to lie flat on an impervious base; it should be supported to permit ventilation all round the coil, and any heat shrinkable taping should be removed. This precaution is necessary to avoid the possibility of chemical reactions taking place within the rubber which result in depolymerisation, a phenomenon which is referred to as reversion. The first sign of this is a softening of the rubber. In general, this problem does not arise if the curing schedule carried out in the absence of ventilation is kept down to a minimum. Where optimum mechanical and solvent resistance properties are required, one to two hours' further curing at 150°C followed by 6 hr to 12 hr at 180°C to 200°C are necessary. However, adequate properties, depending on the service conditions involved, may be obtained by post-curing for 6 hr at 150°C. Where Terylene has been used in the finishing tape, the latter schedule should be used. While silicone rubber has moderately good handling properties in the semi-cured stage and would withstand direct insertion into the slot of a machine without any further curing, this is not generally recommended due to the possibility of reversion occurring, and due to the poor consolidation of the taped insulation unless it is press cured. However, it is unwise to be too dogmatic on this point, as it is possible that cases could occur where little consolidation is necessary and by slowly curing the rubber at a maximum temperature of 130°C no reversion trouble would arise.

While the overall time to process such a machine, including baking times, is considerable and the raw material cost is high, the labour content is low, and hence the process is attractive from the production point of view.

A variant of the unsupported silicone rubber system involves the use of a continuously extruded section of rubber which is made to suit each size of conductor group, and which comprises a one-piece wrap with a flap-type wedge-shaped overlap on one of the shorter sides. Alternative shapes are possible, but essentially the insulation consists of one or two pieces of extruded silicone rubber of appropriate shape bonded together with an overlap of large area. Prior to wrapping, the consolidated conductor group is coated with a silicone rubber adhesive with good void filling properties, to provide the necessary bonding between the conductor and the main insulation. An armouring tape is also used and the insulated coils are consolidated in a heated press as previously described.

Unsupported silicone rubber insulation provides excellent protection against corrosive atmospheres and produces a substantially sealed winding. It has enjoyed particular success in America, where it is reported that unsupported silicone rubber taped machines up to 4,000 h.p. and 6·6 kV have been satisfactorily insulated in this way.[7] However, there will be some machines where the mechanical forces imposed upon the rubber, particularly in the region of the ends of the slots, are such as to require a stronger form of insulation.

Supported Tapes

For several years, glass-supported silicone tapes have been available, but the inter-laminar bond strength and electrical properties have been poor. This, together with their lack of suitable taping characteristics, has weighed heavily against them. However, new supported silicone rubber tapes[8] have become available with high interply bond strength, better handling characteristics, good shelf life and good electrical properties. An example of a sealed machine employing this new reinforced silicone rubber insulation is illustrated in Fig. 7.

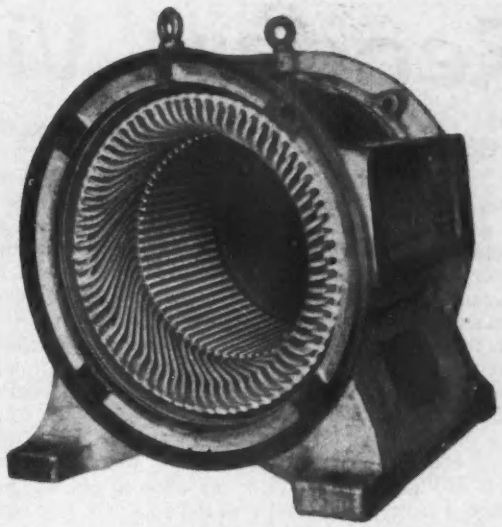


Fig. 7. Stator wound with reinforced silicone elastomer insulated coils. View shows non-connection end

By appropriate selection of the supporting medium and catalyst system, a short curing time is obtained and voids are substantially eliminated, in fact, the electrical characteristics of the unsupported silicone rubber system is approached, while at the same time its strength is greatly improved. A word of caution is required concerning the electric strength of any silicone rubber system. Since its electric strength in terms of volts/mil is particularly dependent on its thickness, any comparisons between one silicone rubber system and another should involve samples of the same thickness. For instance, values of over 1,000 V/mil are possible on test pieces 0·020 in. thick, but at 0·050 in. thick this is usually down to 660 V/mil and at 0·150 in. it is generally nearer 350 V/mil.

Several firms in America are supplying this type of tape with a plain weave reinforcement with a Terylene warp and glass weft. The Terylene warp permits about 5% stretch lengthwise, which is ideal for tight taping, and since it shrinks a small amount further on subsequent heating, consolidation is assisted on curing the silicone rubber. Since glass is used for the weft, no lateral shrinkage takes place and the organic content is kept down to a minimum.

It is anticipated that the major outlet for this type of winding treatment will be in the low and medium voltage field of medium and large industrial machines to make possible a sealed winding in an open type frame.

Acknowledgment

The author wishes to thank his colleagues of Associated Electrical Industries Ltd. at Rugby and Manchester, who have helped in providing the experimental data contained in this paper.

(Concluded)

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Readers Views

Correspondents writing under pseudonyms are asked to submit their names and addresses in confidence to the Editor

Earthing to Service Cables

I READ with great interest *Megohm's* Notes on "Where to Earth," issue 23 March. It has been the practice for some time in the Manchester area to supply an earth bar on the meter board so that the contractor must earth onto this bar on new installations. In my experience of earthing onto the service cable lead sheathing in many parts of Manchester, I found in lots of cases that the cable sheath was not earthed. (I am referring to old installations.) At one time in Manchester it was common practice, especially on the Corporation estates, to feed one house with a service cable from the main cable in the street, then from that house loop out into several houses. In those days the cable was not bonded across in the houses, therefore the cable sheath was not earthed. I have come across such houses where new additions have been added and the service cable has been used for the earthing. It has entailed going into all the houses and bonding the cables, but I wonder how many such installations are still relying on some of these cables which are not bonded, for I have come across such installations from time to time. Therefore it is advisable for a contractor to consult an electricity board before making use of such old cables.

In later years where this looping from one house into the other with the service cable was carried out, brass earth clips and bars were used for the bonding. When inspecting a number of these houses I have found some of these clips and bars corroded away, so interrupting the earth continuity of several installations.

A. Dearden,
WINDHOEK,
S. W. AFRICA.

* * *

I FIND it is most gratifying that the ECA takes up my earthing story, and, indeed, endorses much of it. I feel that the outcome will be earthing to the board's cable sheath or, in the case of rural consumers, the provision of a further earth wire or PME where its use is possible. Bonding will still be done to metal fixtures and pipework at the consumer's end, of course.

With regard to the first paragraph of the ECA letter, I cited one instance and the reply I received. I now quote a further one. I recently wanted to rewire a period-type three-light fitting to provide two switches. I found that it involved drilling out a glued plug in the assembly with great care before I could locate the connectors. I suggested to the manufacturers that a small celeron cover could be provided to facilitate rewiring when required. My reply was: "We have supplied many of these fittings before but received no complaints before."

To sum up, I find that the general standard of installation work has gone up considerably since the 1930's; but equipment, both from safety and access points of view, leaves much to be desired.

E. J. A. Francis,
BRATTON FLEMING,
NORTH DEVON.

* * *

I WONDER if I might make one or two comments on Mr Francis' letter, especially on his first paragraph.

It is indeed the earnest hope of my Association that eventually an electricity board will automatically introduce an earth with the supply cable (as indeed several do at the present time). It has always been the contention of my Association that, as a supply authority introduces what can be a lethal potential, it should be its responsibility also to provide an adequate earth for protective purposes. This can only be done by the provision of an earth terminal in solid metallic contact with the neutral of the supply transformer.

So far as apparatus and accessories are concerned, I can only say that, *in general,* I find manufacturers most co-operative. In the normal course of things, there is the occasional firm which is apparently not interested in making improvements to its product, but I am happy to say that on the whole my experience has been most encouraging.

L. C. Penwill, C.B.E., COMPANION I.E.E.,
DIRECTOR,
ELECTRICAL CONTRACTORS' ASSOCIATION.

More Warnings Wanted

THIS "earthing business" seems to be becoming a matter of who is going to "carry the can back," surely! Electrical contractors and the various boards, as well as the Institution of Electrical Engineers, should take full responsibility for this. After all, water boards do not ask the electrical authorities to help them find leaks in their pipes. I feel sure that the water boards have their own set of problems, and will no doubt wish to share no part of a problem which is not theirs. Why has no one ever tried to introduce some kind of legislation to make homes or dwellings, etc., have an earth plate built in when the home is erected? Surely an earth plate of copper with an earth pin bolted to it cemented in would serve the purpose fully. This would not add greatly to the cost of the house.

I feel sure that the various electricity boards could do more by warning the public in their showrooms and in the Press, of the dangers in not having their wiring systems checked frequently by a competent electrician.

J. Kerswill,
CHISWICK,
LONDON, W.4.

Earth-loop Testing

WITH reference to Mr Sutton's attempt to side-track my letter (27 April); the analogy he gave was very good but did not apply to the case in question.

The fact remains, if you get a low reading on a loop tester it is either good earth or a neutral to earth fault. Which? Who can tell?

Mr Sutton knows this only too well and he almost said so in his last paragraph. Therefore he must admit that (to use his own words) the loop tester is not reliable.

R. W. Marrison,
ATTLEBOROUGH,
NORFOLK.

Automatic production of printed circuits

ETCHING PLANT HAS ELECTRONIC CONTROL

ELECTRONIC control has been applied to the manufacture of printed circuits and certain types of nameplates in a plant installed by Printed Circuits Ltd., an AEI company associated with the engraving firm of Millett, Levens. The plant, which has taken two years to develop, consists of two large cylindrical treatment vats, reminiscent of fairground roundabouts, in which etching, cleaning and drying processes required to form the printed circuits are automatically carried out under time control. Solution strength is controlled electronically by circuits which regulate the pH, or hydrogen ion content, specific gravity on the Baumé scale and temperature in accordance with preset conditions.

So accurate is the control that it has proved possible to use similar techniques, using dyes and sealing chemicals to regulate aluminium anodising so as to ensure continuity of colour, even through long production runs.

Mass Production

The new plant forms an integral part of a recently opened factory designed for the mass production of engraved nameplates and printed circuits. For printed circuit production the factory is equipped with accurate cameras which reduce enlarged drawings of a circuit layout to actual circuit dimensions. For production of small items in quantity, the factory is equipped with a step and repeat camera capable of repeatedly printing the circuit on to a glass negative. The accuracy of this camera, which is graduated to 1/10,000 in., has enabled the company to produce printed circuit sections for "S"-band radar components and also for strain gauges where precise dimensioning is vital. The camera can reproduce the original negative 150 times a minute, considerably reducing the time required for printing the circuit patterns.

The pattern is transferred to the copper laminate by offset printing and, before the acid etch, the circuit pattern, now outlined in ink, is coated with bitumen dust and baked by infra-red heaters. This process ensures that the circuit pattern remains unchanged during agitation in the etching bath. The copper laminates, with the printed circuit patterns on, are then attached in batches to arms which carry them through the various etching and cleaning processes in the cylindrical vat. On this machine, cleaning is followed by agitated etch, during which acid is forced under pressure on to the plates. Subsequently, they are rinsed and dried, still under automatic control. Several boards can be treated together, the complete etching process taking only about seven minutes.

After etching, the individual printed circuit boards are cut to size and punched with appropriate terminal and fixing holes. By etching the original circuit pattern on to the punch die, accurate alignment of hole and punch position is ensured and the laborious marking out required for a complicated press tool is eliminated.

Application of mass production techniques, developed for nameplate production, has enabled printed circuits to be made at prices competitive not only with European manufacturers but also with the Japanese. The cost of mass-produced printed circuits is between 0·6d and 0·8d per sq in., while the rejection rate in the factory averages only 2%.

A laboratory with dust-free, controlled atmosphere has also been built by the company to pursue development work on micro-miniature and solid state electronic devices. Also in the final stages of development is a printed circuit motor armature formed on an 0·03 in. thick laminate. The armature has 97 conductors, 0·004 in. thick, forming an eight-pole wave winding. Although only in the experimental stage, motors up to 2 h.p. rating are envisaged. Printed circuits have also recently been produced for sub-miniature valve circuitry using Perspex.

In the control gear field, printed circuit wiring is used in the "Macfire" oil-firing control unit for boilers in which the components are linked by printed wiring suitable for a current rating of 3 A. Strain gauges are also being produced to close electrical tolerances from cupro-nickel foil only 0·0002 in. thick. The gauges are formed on a plastics backing material.

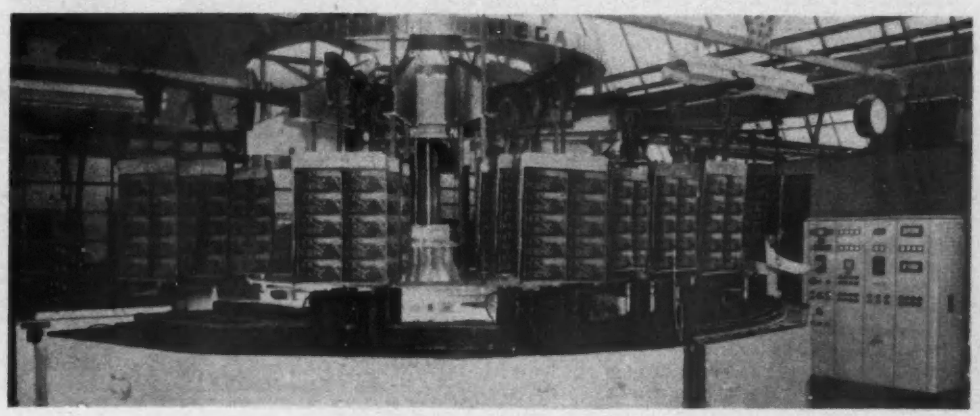
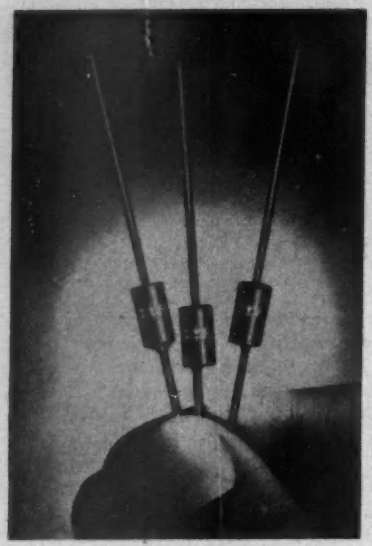


Fig. 1. Resembling a roundabout, this machine cleans, etches, rinses and dries copper laminates to form printed circuits. Electronic circuits control the solution with great accuracy and enable anodising also to be carried out with precise control of colour



International Rectifier Co. diffused junction miniature diodes

R.E.C.M.F. moves to Olympia

RAPID SEMICONDUCTOR DEVELOPMENTS SET PACE FOR THRIVING ELECTRONICS INDUSTRY

Exhibition open 10 a.m.—6 p.m. (9 p.m. 31 May), 30 May—2 June

THREE times as big as its predecessor of two years ago, the 1961 Radio and Electronic Component Show has moved from Grosvenor Hse to Olympia. 250 stands will represent manufacturers of a rapidly expanding field, whose impact is being felt in many branches of industry today.

Electronic components have now grown to be a valuable British export. This year's exhibition bears evidence of the continued evolution and refinement of transistor and printed circuit techniques with ancillary components following suit to achieve ultimate goals of greater reliability and compactness.

Semiconductors

Nowhere has progress been so spectacular as in the semiconductor field. Of the light current category, ratings and characteristics of types which will be on display show a bewildering variety. Applications range from telecommunications and control circuitry to instrumentation and computers. Despite main emphasis being on light current devices, several manufacturers will exhibit power rectifiers and control devices. Silicon controlled rectifiers to be shown by AEI have ratings of up to as high as 100 A, and the same company will have on display American type controlled rectifiers. Westinghouse are to feature silicon controlled devices incorporated in motor control gear and power regulating equipment. Other items on the Westinghouse stand include copper oxide and selenium rectifiers, in addition to germanium and silicon units, providing a wide selection of components for building up various sizes and types of power supply equipment. In the same category, Joseph Lucas Ltd. will have a range of silicon devices, among them zener regulators.

Some of the newer types of transistor to be displayed not only give improved frequency and switching characteristics coupled with greater temperature stability and reliability, but also lend themselves to automatic production and continuous quality control. These features are exemplified in the micro-alloy diffused base transistors to be exhibited by Semiconductors Ltd. Highlight of this stand will be examples of transistorised high-speed transistor circuitry. Another recent type is the epitaxial silicon transistor on the Ferranti stand. Other devices which will be shown by Ferranti include zener reference and variable capacitance silicon diodes. In the latter device, capacitance is proportional to applied voltage. An application of this characteristic is in remote trimming of tuned circuits to be demonstrated on the Hughes International (UK) Ltd. stand. The fast operation of subminiature "dot" diodes will also be demonstrated. Incorporating the latest diffused junction techniques, a range of axial lead, miniature silicon diodes is to be featured by the International Rectifier (GB) Co. Ltd.

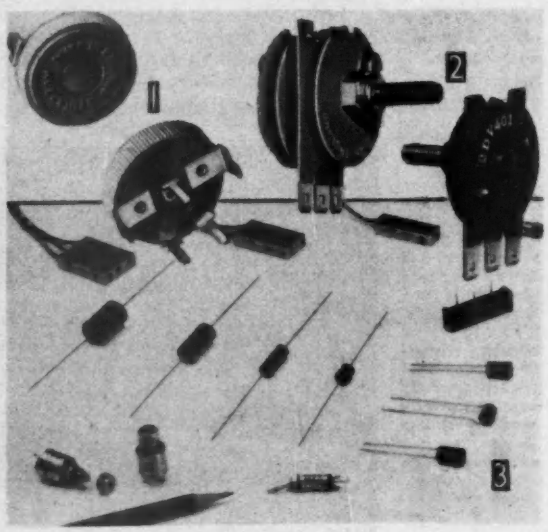
Accurate prediction of transistor reliability has been considerably simplified by a special testing technique which will be illustrated on the Mullard stand. Results from up to 10,000 transistors on life test are sampled in sequence and fed to a computer for statistical analysis. By this means, reliability data equivalent to millions of hours annually of life testing can be compiled.

Industrial Valves

Notwithstanding the ever-widening applications of semiconductors there are still a number of sectors of industrial electronics where thermionic valves and cold cathode devices hold their own. A typical example is that of r.f. heating, for which at least three firms will display triode and tetrode oscillator valves incorporating various types of cooling, including vapour cooling. The firms concerned are STC, AEI and English Electric whose exhibits, combined with those of GEC, will also cover various types of u.h.f. telecommunications and radar tubes, thyratrons and cathode ray tubes. AEI, in particular, will feature large types of ignitron for capacitor discharge duty and a range of gas-filled thyratrons, which have starting times very much less than their mercury vapour equivalents.

Resistors

Following the lead set by transistors in miniaturisation, other electronic components are being produced to match, with particular reference to the standard printed circuit module. Thus, among a



1. Morganite Resistors miniature edge potentiometer for printed circuits

2. Lucas semiconductor rectifiers

3. Components in the Electro-thermal range

wide range of resistors to be shown by Morganite Resistors Ltd. is an edge control potentiometer comparable in size to a threepenny piece and having a dissipation of 0·25 W. A new range of "Arcol" precision resistors by the Ashburton Resistance Co. incorporate stout tinned copper leads to obviate fracture when connected to printed circuit boards. Also to be featured by this company are enclosed versions of a heavy-duty range of resistors, rated from 200 W to 750 W. New products by Erie Resistor Ltd. will include both carbon and wirewound miniature resistors for use with printed circuits. Among the large number of different components by Plessey, there is a range of glass-fibre core wirewound resistors and a comprehensive range of "Metallux" metal film resistors which include hermetically sealed and fully insulated types.

Capacitors

For potted subminiature circuit assemblies, tantalum electrolytic capacitors will be in evidence on a number of stands. These are suitable for working up to 125°C and can be of the wet or dry type. They are to be featured both by Hunt Capacitors and TCC, together with various metallised film and metallised paper tubular capacitors. In addition to the more usual metal capacitor envelopes, plastics and synthetic resin cases will also be featured. Well established for reliability, polystyrene dielectric capacitors will be displayed by Plessey and Suflex.

Printed Circuits and Connectors

Forming the basis of reliability and ease of production of modern electronic equipment, examples of printed circuits will feature on a large number of stands. Of firms specialising in printed circuit processing, such as Technograph and Printed Circuits, the latter will show their "Plasmet" range of etched wiring circuits. Applications include computers, process timers and printed armatures for small electric motors. A major supplier of raw material for printed circuits are De la Rue, who manufacture various grades of resin bonded kraft paper, fabric and glass-fibre copper foil laminates. This company will display various manufacturers' equipment incorporating printed circuitry, including a computer and an electronic organ.

Various firms have developed connectors and fittings specifically for printed circuits. Among these, TCC will exhibit their "Flexistrip" multiway feeder. This consists of copper strip conductors in flat formation embedded in transparent polyester. It forms a flexible means of interconnection between printed circuit boards. Multi-way plugs and sockets for this "ribbon" feeder can be seen on the Belling and Lee stand together with other printed circuit fittings. Also for printed circuit mounting is the AEI "Clix" range, which includes a miniature stud switch, wander plugs and connectors.

In parallel with printed circuit developments for electronic equipment, an increasing trend is the use of p.t.f.e. insulation for equipment wiring, multicore and r.f. cables. One advantage of this versatile material is good high temperature performance. Examples of the use of p.t.f.e. can be seen among the wide assortment of cables shown on the BICC and AEI stands. For winding miniature coils, the London Electric Wire and Smiths will be showing their solderable enamelled wires, some as fine as 0·001 in. diameter.

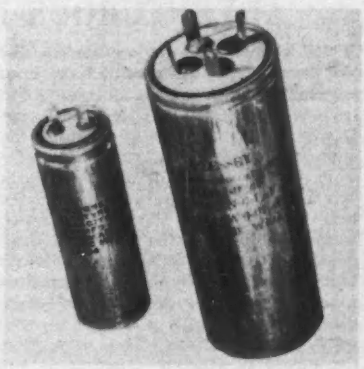
Materials

Perhaps more than in any industry, progress in electronics is vitally dependent on the introduction of new materials, and reliability of individual components is largely determined by the quality of materials. A material originally conceived as an adhesive, "Araldite" epoxy resin continues to be held in high esteem for encapsulation of components and packaged circuits. Examples of its application in this field will be seen on the Ciba stand, together with resin moulded components. Also used for potting purposes is cold-cure "Silastomer," one of the many silicone products to be featured by Midland Silicones Ltd. Advantage of this material is that it cures at room temperature and is particularly suitable for encapsulating delicate components. Other grades of "Silastomer" are used for wire insulation and sleeving for reliable high temperature operation.

A traditional bugbear to the reliability of electronic equipment used to be the possibility of failure of soldered joints. This has now been largely eliminated by the wide range of solders now available, having just the right balance of alloy and flux for the particular soldering application. Multicore Solders will have a large stand exhibiting their range of solders which, besides covering the well-known "Ersin" cored type, also covers solders in ring and pellet form for automatic soldering applications.

Instruments

An essential adjunct to component production is accurate means of testing that performance and characteristics conform with specification. Instruments for this purpose will be featured on a number of stands. One new introduction by Avo Ltd., a portable transistor tester, is said to be the only one of its kind having facilities for transistor "noise" measurement. Instruments by British Physical Laboratories will include an electrolytic capacitance bridge and automatic comparator equipment for checking tolerance limits of components, which can be handled at the rate of 6,000/hr. Telequipment will be showing their "Serviscope" range of compact high-performance oscilloscopes for service engineers. A tool for research into dielectrics and resistance materials and for routine checking, the Wayne Kerr "Universal" bridge will measure conductivity, permittivity and loss factor of both solids and liquids. Also shown will be computer for determination of transfer function of networks.



Plessey polystyrene dielectric capacitors

1. Examples of the heavy-duty range of resistors by the Ashburton Resistance Co. Ltd.
2. Shown for the first time the latest "Serviscope" by Telequipment
3. Wayne Kerr "Universal" bridge for dielectrics

Electronics in the Steel Industry

THE British Iron and Steel Research Association, in this year's annual report,* makes a number of interesting references to contributions by the allied sciences of electronics and ultrasonics to ferrous metals production and fabrication. Some are the purely functional—but extremely important—applications to automatic control of processes and equipment; others are in the fields of metallurgical research.

A typical example of the former is "APIC," a controller developed for regulating arc furnace currents. On a prototype 30 ton furnace, this has achieved a reduction in electrode consumption of 2 lb/ton of steel and electricity consumption by 25-50 units/ton.

Another example is a system of remote positional control on rolling mill screwdown, using a pulse generator. The pulses, at 200/effective inch of screwdown, are also fed to a two-way counter giving both an accurate measure of the position of the screwdown motor shaft and the time to achieve each setting. The equipment, applied to a 50 h.p. motor simulating an installation on a rolling mill, has been used on a series of comparative tests, both manual and automatic. Now the *Pegasus* computer is analysing the results, but preliminary calculations indicate that automatic working gives greater accuracy of setting, but little improvement in time over manual.

A prototype equipment of this type has already been installed on the primary mill of a large steelworks and over 1,000 tons of steel rolled with it.

The system has also been applied to longitudinal drives, the pulses here being scaled to eight to the inch. Using a crude type of motor control, stopping within one count, an accuracy of $\frac{1}{4}$ in. in 100 ft can be attained.

Computer Applications

The report also makes reference to the uses of computers in the industry including that described in these pages last week (page 798). The "Tallimarker," a prototype motor uniselector analogue/digital converter to give automatic weighing of scrap bogies as they travel across a weighbridge, was commissioned during the year and has served to stimulate interest in practical digital recording of data of this type.

The BISRA *Pegasus* has been used for about 50 hr of productive work each week of which 40% was for hired time by member firms. The department is keeping abreast of new ideas in computer techniques for the benefit of members and a new general purpose analogue computer has been added to the Association's facilities in this field.

Ultrasonic Flaw Detection

In conjunction with Kelvin and Hughes, the Association has developed a method of continuous inspection of steel sheet for laminations by ultrasonic methods.

The twin probe, containing transmitter and echo receiver, is located near one longitudinal edge of the sheet. Ultrasonic pulses are fired across the width of the sheet and echoes from defects are received, amplified and displayed on a c.r.t. or used to trigger a reject gate. Good results have been obtained at a line speed of 80 ft/min. It is now being developed for line speeds up to 300 ft/min.

Another development which is being assessed is for inspection of surface finish on tinplate. Two lines of instrumental aids are being examined; the first a multichannel photo-electric system, the second a combination of TV camera and image arrester.

Probe Micro-analyser

In an entirely different field is the electron probe micro-analyser, an AEI device which will analyse a spot only $\frac{1}{2}$ micron diameter for elements above atomic number 22 (titanium). It is devised for the studies of inhomogeneities in steel as inclusions, distribution of alloying elements, etc.

Yet another field in which progress has been made is the coating of steel strip with aluminium by electrophoresis. The properties of the new coated steel (Elphal) are said to be most attractive. Porosity is so low that the surface may be anodised and the strip can be severely deformed without deterioration of the aluminium coating.

* The BISRA Annual Report, 1961, British Iron and Steel Research Assn., 11 Park La, London W.1.

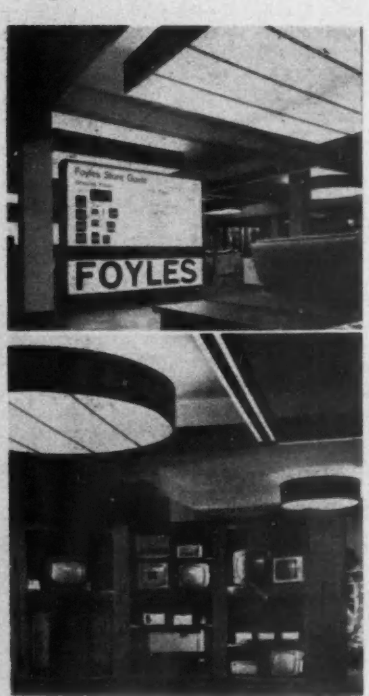
ADVENTUROUS LIGHTING DESIGN

THE problem of accommodating five departments at ground-floor level together with accounts and information sections was one that faced Conran Design Group when they planned the interior of Foyles, a new Gloucester store. Foyles called for a design which was a fresh approach, would make the best use of selling space and which would eliminate clutter and unco-ordinated displays. The Design Group decided that space would be wasted in erecting a series of screens or partitions to demarcate the various sections, so they used electric lighting. This gave them the means of defining departments and indicating customer circulation. From the two main entrances circulation was established by a line of light over the main gangways from which the departments radiated. Departments themselves and feature displays were each illuminated by large circular or rectangular lighting boxes which provided focal centres.

Lighting throughout played an important part in the appearance of the store and the standard of illumination was higher than the degree generally accepted in this country. Tungsten and colour-corrected fluorescent lamps were intermingled to give balanced density, while displays were highlighted by spotlights concealed in the lighting boxes.

Another feature, seen in the illustration, was back-lit guides to the store with graphic representation of departmental layout. In the ground-floor lighting department, fittings are displayed on platforms and a trunking system has been installed for standard and pendant lights so that flexes are concealed.

Window design was carried out by Kenneth Gibson, A.R.I.B.A., who made provision for room settings to display furniture. This was conceived with screens and semi-transparent slatted barriers. Depth was given to these settings by the use of an overall ceiling treatment of natural timber boarding concealing display lighting. For domestic appliances, the architect ensured versatility by using readily adaptable shelving and display systems. The first floor store was divided in three ways, a carpet department, clear space for furniture exhibitions and hairdressing salon. Here, fluorescent lighting was used for overall effect and spotlights highlighted special carpet and furniture arrangements.



Above, the entrance foyer showing the illuminated store guide. Below, a view of the television and radio department

AROUND THE TRADE

BY PEREGRIN

A TOUCH of sunshine after the long cold spell and every electrical shop window in the neighbourhood has sprouted refrigerators. Displayed in all shapes, sizes and colours; doors open, doors closed; with mock food or empty; massed in one particular make, or crowded with several different makes; tipped up, tipped back for better viewing; all with the same obvious intent—to titillate the public appetite and make good last year's loss. More power to their elbow: I am doing the very same. But what about washing machines? I do not see the same VIP treatment being meted out to them: yet the same sales position prevails. Surely this is the time to clear old stocks just when the combination of sun and wind tempts the housewife to wash her blankets at home rather than submit them to the not-so-tender ministrations of the laundries.

Washing Machines

Home sales figures as provided by the Board of Trade leave me puzzled at the introduction of more new and expensive models of washing machine: the latest being the Bendix Triomatic, following hard on the heels of the Hoover Keymatic. This new Bendix job was launched at the end of April in a sea of cocktails, wines and spirits with, for ballast, the usual funny little bits and pieces of food which ruin the poor dealer's digestion without satisfying his appetite. These launchings must certainly cost Bendix a packet; and Hoover's, which was supremely well done, at least two! But although they seem both excellent machines and worthy of a fanfare, I would have expected that Hoover's, at least, would have been more anxious to clear their sticking stock than plump for an entirely new model. Perhaps they had gone too far with their arrangements before the slump or perhaps they just wanted to ensure that they were not pipped at the post. Whichever it is, I notice that the bulk of their advertising is directed at selling the old Hoovermatic rather than the latest addition to their range.

There is one thing I will say; and that is, for years we have had new washing machines introduced in a blaze of publicity which, on inspection, proved to be just a rehash of the old, but now at least we have something worth shouting about. I like the simplicity of the controls: Hoover's indented key plate which operates the contacts according to the washing sequence required and the Bendix simple knob controls and its changeover switch with the diaphragm type of valve for the washing and drying sequence. I like the fact that washing can be ironing dry or bone dry, and I like the exhaust pipe to take away wash-day smells from the kitchen and also the fluff trap which is presumably to protect the bronchial tubes of the user. I wonder, however, why neither have a forward and reverse action as the laundry machines have and, indeed, are incorporated in some of the Continental models. Too expensive? Too wearing? Too difficult to make? Or not so good? I wonder! Perhaps the price of the present models is already a bit steep, with the advertising costs in newspapers, magazines, periodicals and ITV commercials: not so much, perhaps, on dealer-to-customer publicity. Still, we sold washing machines before either Hoover or Bendix models were born, so we can receive these grand new models with equanimity.

Apprentices

I was interested in a report of remarks made on TV by a Youth Employment Officer about apprentices. Apparently he complained that the Midlands employers were lagging behind in the training of youths and particularly in their technical education. I would like to have told him that this position is not peculiar to the Midlands but obtains in all dense industrial areas; and that the fault does not lie with the employers, but with the youths themselves and with their parents. I do not know the manufacturers' difficulties, although I hear they are similar to the contractors' when they send their youthful employees to a one or two days' course—with pay—at the local tech. on the understanding that one evening a week is given up to this course. At the end of term most contractors have found that about 5% have passed the exam, that of the rest they have either left for a job where "they don't have to go back to school," failed to turn up for evening classes more than once, or played about in the daytime to the complete exclusion of learning. Appeals made to the boys' parents are usually met with either blank indifference or a quite ferocious resentment at the implied criticism—never with co-operation. It should be pointed out to the Youth Officer concerned that the success of even one ewe lamb is a matter for celebration, that in most cases the only result is a deep and unrewarded hole in the employers' pockets and that his criticism should be more constructive and levelled in the right direction—at the parents, not the employers.

Retailing Costs

I see we have another increase in shop wages pending and that at a time when the five-day week is under discussion. I wonder why we get so little information and guidance on these matters from NECTA? Now that we have a flourishing retail section surely we should have more than the odd occasional LCP circular. Apparently the retailer is still the poor relation of the Association. I had a query from my showroom department recently regarding the disposal of unclaimed goods, and had to search my files for the appropriate circular. Surely matters of this sort could be housed in a section of the ECA Year Book. Retailers pay their subscriptions as well as contractors, so why should they not have equal facilities? Why not a section covering the Shop Acts; the Retail Furnishing and Allied Trades Council; liabilities concerning goods for repair; damage or injury to person and property; and the question of whose is the ten bob note swept up off the floor? I expect LCP will argue lack of room or addition to costs. But if the size of the book was increased to include retail matters, appliance manufacturers would be tempted to advertise in it and help cover the extra cost. Otherwise let us have a separate booklet on the lines of the NFEA National Working Rules. We would willingly forego the photographs for the sake of having all our information under one roof.

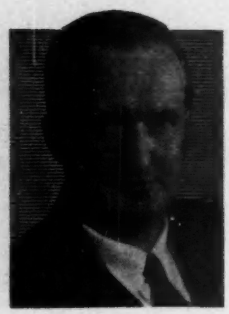
Personalities *in the industry*

Mr L. E. Atha

Miss H. M. Hartop

Mr A. G. Connell

Mr C. J. Sellers



Mr E. S. Booth

Previously with Prestcold, **Mr L. E. Atha** has joined Morphy-Richards (Cray) Ltd. as commercial manager and assistant to **Mr R. M. Morgan,** sales director. Mr Atha's duties will include the co-ordinating of sales force activities.

New member of English Electric's team of home economists is **Miss H. M. Hartop.** She is to work in the Southern area and will be based at the company's Tonbridge, Kent, office. Before joining English Electric, Miss Hartop was the senior housecraft adviser to the Revo Electric Co. Prior to that she was chief demonstrator of the London Electricity Board, West Ham area.

Mr J. Caskell, A.M.I.E.E., assistant construction engineer with the South of Scotland Electricity Board, has been appointed a life trustee of the Carnegie Dunfermline and Hero Fund Trustees.

Chief engineer of the East Midlands Electricity Board since 1948, **Mr A. G. Connell,** M.I.E.E., M.I.MECH.E., F.INST.F., is to retire from that position in November next, and the Board are now seeking a successor (*ESH, page 113). Prior to nationalisation of the industry, Mr Connell was chief engineer and manager for the Halifax Corporation undertaking for eight years, following five years as chief electrical engineer to the Staveley Iron and Coal Co. Between 1930 and 1933 he was on consulting work with Merz and McLellan, being resident engineer for the CEB's South East England scheme. This followed some eight years with the Foundation Co. Ltd., during which he was engaged on civil and power engineering, including work on a hydro-electric scheme in Africa. His early training and experience was gained with Fraser and Chalmers and the English Electric Co., with whom he specialised on steam turbine design and contract business. Mr Connell is a past-chairman of the North Midlands Centre of the IEE. He was also a member of the Technical Committee, set up in March, 1939, which revised the Regulations for the use of Electricity in Mines.

Mr C. J. Sellers has been appointed national sales manager for Remington Electric Shaver Ltd. He was previously employed with the Remington Co. in Germany, and has had wide experience of marketing operations in Europe.

Mr Geoffrey Parr, M.I.E.E., was the recipient of a presentation recently on his retirement from the position of honorary secretary of the Television Society. His present—a television receiver. The presentation was made by **Sir Harold Bishop,** C.B.E., M.I.E.E., on behalf of the council and members. Mr Parr's successor is **Mr C. A. Marshall,** B.SC., A.M.I.E.E.

Mr Lloyd M. Powell has been elected chairman of Dictaphone, succeeding the late Mr C. K. Woodbridge. Mr Powell has been president and a director of Dictaphone Corporation, US, since 1953.

Philips Electrical Ltd. have promoted **Mr H. E. Godfrey** to be commercial manager, television, directly responsible to **Mr A. L. Sutherland,** the radio, TV and ELA group commercial manager.

The Electrical Research Association announces that the composition of Divisional Committee No. 2—Power Plant, which held its first meeting this month, is as follows: **Mr E. S. Booth,** chairman (CEGB); **Dr A. T. Bowden** (C. A. Parsons and Co.); **Mr J. Caldwell** (English Electric Co.); **Mr W. W. Campbell** (Merz and McLellan); **Dr W. H. Darlington** (AEI Ltd.); **Mr F. Dransfield** (CEGB); **Mr M. G. Gemmill** (CEGB); **Mr J. B. Jackson** (CEGB); **Mr E. Hywel Jones** (South of Scotland Electricity Board); **Mr K. J. McKillop** (Water-Tube Boilermakers' Association); **Mr J. Mayer** (International Combustion Ltd.); **Mr J. M. Mitchell** (GEC); **Mr C. W. Priest** (CEGB); and **Mr W. F. C. Schaap** (Babcock and Wilcox Ltd.). **Dr H. G. Taylor,** director of the ERA, is an *ex officio* member of the Committee, and the secretary is **Mr G. A. W. Taylor,** of the Association.

Mr E. Turner, deputy chairman of Birmingham Small Arms, has been elected a director of Associated Electrical Industries Ltd.

Mr J. K. Downing has been appointed an executive director of Vent-Axia Ltd., a member of the Hall-Thermotank group.

Assistant general manager of the New Zealand Electricity Department since 1948, **Mr L. F. Withers,** M.I.E.E., M.N.Z.I.E., has retired.

Manager of the Education Department, AEI (Manchester) Ltd., since 1956, **Mr R. F. Marshall,** B.SC.(ENG.), A.M.I.MECH.E., A.M.I.E.E., has been promoted to central education manager to Associated Electrical Industries Ltd. **Dr D. Baird,** B.A.(HONS.), D.SC., becomes central personnel manager. Dr Baird joined AEI last year as assistant manager, personnel services. Mr Marshall joined Metropolitan-Vickers as a college apprentice in 1936 and became a technical assistant in the Education Dept. in 1940. He was section leader, professional engineering training, from 1951 to 1954 when he became assistant manager for professional apprentice recruitment and training. He is currently a member of the FBI and BEAMA Education Committees and of the Practical Training Committee of the IEE.

Mr W. F. Oakley, director of the Automatic Telephone and Electric Co. Ltd., has been elected chairman of the Telecommunication Engineering and Manufacturing Association. The new

* *Denotes revision to the "Electricity Supply Handbook, 1961."*

vice-chairman is **Mr W. G. Patterson,** M.B.E., Divisional director and general manager of Associated Electrical Industries Ltd.

Mr T. W. Smith has been appointed North-East Coast representative for Berry's Electric Magicoal Ltd. He was previously with Black and Decker and with a northern distributor of electrical hand tools. Based on Newcastle he takes over the area for which the late Mr A. L. Sharpe was responsible.

At present engineer for the Gt. Yarmouth and Lowestoft district of the Eastern Electricity Board, **Mr J. E. Walker,** A.M.I.E.E., has been appointed manager of the Board's Colchester district, to succeed **Mr G. P. Dixon,** A.M.I.MECH.E., on his retirement (*ESH, pages 109, 112). Mr Walker, who was educated at Alleynes Grammar School, entered the electricity supply industry in 1933. Prior to this he received initial training with the former London and North Eastern Railway Co. and Crompton Parkinson Ltd. His technical education was undertaken at Rutherford Technical College, Newcastle; Regent Street Polytechnic and Northampton Polytechnic, London. He joined the former Northmet Power Co. as a junior engineer, becoming engineer, Stevenage district in 1949. He took up his present appointment in 1953. Mr Walker is a Board's member on the Eastern District Joint Advisory Council and in 1956 attended a management practice course at Wadham College, Oxford. Under staff development arrangements he has exchanged posts with the commercial engineer, Norwich district.

Mr A. Robertson, of Alex Robertson and Co., Glasgow, was elected president of the Electrical Contractors' Association of Scotland at the annual conference at Dunblane last week. The new vice-president is **Mr H. G. MacKerron,** of MacKerron and Scott Ltd.

OBITUARY

Mr J. W. Ryde, F.INST.P., F.R.S., chief scientist of the General Electric Co.'s Hirst Research Centre, Wembley, since 1953, died on 15 May, aged 63. During these recent years he had overall responsibility for the programmes of pure scientific research of the establishment with particular interests in the fields of new materials, crystal growing and solid state physics. Educated at St. Paul's School and the City and Guilds Technical College, where he studied under Prof Sylvanus P. Thompson, Mr Ryde joined the GEC Research Laboratories as a physicist in 1919, following war service. His many and varied early research studies included pure spectroscopy, the gaseous electrical discharge and thermionics. His work on the scattering of light, first applied in the 'twenties to optical diffusing media in glasses, was developed by him during World War II to classic studies of the attenuation and the radar echoes produced by meteorological phenomena at centimetre wavelengths. He made significant contributions to the development of electrical discharge lamps, luminescent materials and optical projection systems. His researches in World War II included velocity modulation tubes and crystal valves for microwave mixer devices, together with work on the FIDO fog dispersal system. He was a member of the Royal Institution of Great Britain since 1935 and chairman of the Davy Faraday Laboratory Committee of the Institution since 1951. He also served on the Board of Managers of the Institution.

Mr A. J. Hunt, joint manager of the Herne Bay/Canterbury district of the South Eastern Electricity Board, died on 14 May, aged 66 (*ESH, page 89). The Hunt family were the pioneers of electricity supply in Herne Bay and in 1926 they, together with the Callender's Cables Co. Ltd., formed the Herne Bay and District Electricity Supply Co. Ltd., of which Mr A. J. Hunt was director, engineer and joint manager prior to 1948.

NEW LITERATURE

Thermoelectric Materials and Devices

ed. by I. B. Cadoff and E. Miller

IN June, 1960, New York University organised a course with the same title as this book. It is the lectures delivered then that comprise this book. The appeal is to engineers as well as physicists, and the level of discussion is fairly advanced. A start is made with a brief discussion of thermo-electric phenomena, and the characteristics of the thermo-electric circuit, after which attention is given to thermo-electric figure of merit. Materials are discussed under a number of headings, with attention to those considered promising in current engineering development. The volume then turns to engineering design topics, with chapters on design and efficiency calculations and on special considerations of direct conversion from nuclear heat sources to electricity. Applications to refrigeration as well as electricity generation receive attention in this most welcome book which will be useful for reference as well as initial study. Published by Chapman and Hall, 344 pages, 9 in. by 6 in. Price 78s.

Engineering Management

by S. A. Robertson, B.SC.(ENG.), B.COM., WH.EX., A.M.I.C.E., M.I.MECH.E.

WELL received when it was first published in 1948, this textbook's second edition adds sections on cybernetics and operational research as aids to theory and practice of management. It thus maintains the general theme of the book which stresses the importance of scientific method in collecting and analysing facts upon which to base managerial policy and decision. The original text remains essentially the same except that certain chapters have been revised to include reference to recently formed official bodies, such as the Institute of Management, and to the latest governmental reforms affecting industrial welfare and training. Bibliographies, included at the end of each chapter, have also been brought up to date. Published by Blackie and Son Ltd., 467 pages, 6 in. by 9 in. Second edition, price 30s.

Two Hundred Precious Metal Years

by R. E. Wilson

IN 1760, when George III was on the throne, a young man settled in Sheffield and, because he did not wish to adopt the family occupation of farming, turned to metal smelting as his trade. The man's name was John Read and his partner in the enterprise was his uncle, Samuel Lucas. Their basic occupation was the recovery of precious metals from the wastes of the industry with, as another line, the manufacture of vitriol. Today the Sheffield Smelting Co. Ltd., with an issued share capital of over £1 million, has on its board the last of the lineal descendants of John Read who here traces the history, with its successes and setbacks, over the intervening two centuries.

As with all such historical surveys, while the main interest is naturally for those in the precious metal industries, there is much here which will equally fascinate the average reader with a thirst for general historical knowledge of industrial Britain in the eighteenth and nineteenth centuries. Published by Ernest Benn, 295 pages, 9 in. by 5½ in. Price 63s.

BOOKS RECEIVED

A Guide to Technical Writing, by C. Baker. Brief guide covering writing technicalities, preparation of copy and illustration. Published by Sir Isaac Pitman, 101 pages, 7¼ in. by 4½ in. Price 15s.

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Copper and aluminium in electric cables

by C. C. Barnes, M.I.E.E., M.A.I.E.E., A.B.I.M.*

Part 3

PREVIOUS parts of this article have covered the economic factors in supply of copper and aluminium, conductor manufacture and jointing, and sheathing of the principal types of cable. In the present, concluding part, attention is given to standardisation of cable metals, to some special forms of copper-sheathed cable, to rating problems, and to the latest development in aluminium conductor cables.

Standards for Conductors and Cables

In 1952, BS 1036 and BS 1037 were issued to cover, respectively, electrolytic and fire refined tough pitch conductivity copper, the raw material used in wire production. For cables, copper is almost invariably used in the annealed condition, whereas copper used for o.h. lines is hard drawn for mechanical reasons. BS 128 "Bare annealed copper wire for electrical machinery and apparatus" is the relevant British Standard.

The conductor size for power cables is determined by thermal and electrical requirements as the appropriate dimensions give adequate mechanical strength, but telephone cables carry very small currents and, therefore, other factors have to be considered.

In general, for switchboard and indoor telephone cables the conductor size is settled by cable-handling requirements. With long trunk audio circuits, conductor resistance is of less importance as loading and repeaters mitigate transmission losses. Detailed requirements for copper conductors are specified in numerous British Standards (e.g., BS 7:1953, BS 480:1954, BS 638:1954, BS 708:1957, BS 883:1958 and BS 1116:1956, etc.), but the repetition of this information will be unnecessary in the future following the publication of BS 3360:1961 and BS 3361:1961 for "Copper Conductors in Insulated Cables and Cords."

BS 2627:1955, "Wrought Aluminium for Electrical Purposes-Wire," relates to wire used for electrical conductors, such as overhead transmission lines, insulated cables, or windings for rotating machinery or transformers.

Other relevant British Standards are BS 215:1956, "Steel-cored Aluminium Conductors" and "Aluminium Conductors" (issued in two parts), and BS E.21:1952, "Electric Cables for Aircraft" (now being revised).

BS 2791:1956, "Aluminium Conductors in Insulated Cables," specifies dimensions and requirements for a series of standard sizes of aluminium conductors: the resistance of most of them is within $\pm 10\%$ of that of the corresponding standard copper conductor. Some additional sizes of single-wire conductors, not required for power purposes, have been included because of their possible use in other types of insulated cables, e.g., telephone cables.

BS 2791 states requirements for the conductor in the finished cable, i.e., after the stranding operation. Requirements for the aluminium wire before stranding are given in BS 2627. Aluminium conductors to BS 2791 are made from wire GIE in the ¼H or H conditions—as specified in BS 2627. The particular temper is selected by the cable manufacturer.

Through the International Electrotechnical Commission, agreement has been reached on a standard value of 2·8264 microhm-centimetre at 20°C (68°F) for the resistivity of hard drawn electrical purity aluminium wire. This standard value may be used for calculating conductor resistance for electrical purity aluminium in both wire and bar form.

The decision to adopt either copper conductors or aluminium conductors for any specific project is mainly determined by the relative prices of these materials ruling at the time. It is, therefore, logical for British Standards to cater for both types of conductors, their relative suitability for particular applications being the immediate responsibility of the user and/or manufacturer concerned.

This attitude has been adopted for many years in the German VDE Specification (e.g., VDE 0271:1957—Specification for cable with rubber insulation and rubber covering, or with rubber covering or with plastics insulation and plastics covering for heavy current installations) and in the French Specification, NF C.33:100 (May, 1959), "Câbles sous plomb isoles au papier imprégné," covering the voltage range 1 kV to 30 kV inclusive.

In certain cases, reservations are introduced as, for example, relating to the use of flexible conductors made up from aluminium wires in the small diameter range (e.g., 0·0076 in., 0·012 in., 0·018 in., 0·036 in. and 0·044 in. diameters) as indicated by the following note in the foreword of BS 1862:1959, "Cables for Vehicles": "It is recognised that electric cables with aluminium conductors are being used experimentally in road vehicles, but it is considered that more experience in their use is necessary before they can be included in this British Standard (1862)." British Standard 760:1956, "Wire-Armoured Paper-Insulated Cables for Use in Mines," also contains the following observation re aluminium sheathing in its foreword: "Although aluminium-sheathed cables are now available, it has not been considered desirable to include them in this Standard (760) until further experience has been obtained."

BS 480, Part 2: 1954, "Impregnated Paper Insulated Cables for Electricity Supply," specifies requirements for aluminium-sheathed cables (died down process only) for working voltages up to and including 22 kV.

Mineral Insulated Copper Covered Cables

This type of cable was invented in France and manufactured and developed in this country by Pyrotenax Ltd. particularly for use in hot situations or where a fire hazard is especially serious. Another British cable-maker is now manufacturing m.i.c.c. cables. It is not claimed that m.i.c.c. cable can economically replace paper-insulated cables for underground mains, but it is being used in many instances in place of vulcanised rubber or thermoplastic-insulated cables drawn in black enamelled steel conduit, where high or low temperature conditions or architectural features are important aspects in the choice of wiring.

* Mr Barnes is with the CEGB. Part 1 of this article was published on 13 April, part 2 on 11 May.

M.I.C.C. cable consists of copper conductor(s) insulated with a highly compressed magnesium oxide (MgO) and enclosed in a seamless copper tubing. The manufacturing process necessary to ensure the compression of the dielectric and its complete enclosure to exclude moisture consists of building up a short section containing the requisite proportion of conductor, dielectric, and sheath, and then drawing them down through a succession of steel dies until the required final dimensions and length are obtained. In this form the cable is very hard and, in order to render it sufficiently ductile for using, it is annealed at a temperature of the order of 500°C to 600°C. The main characteristics of these cables may be summarised as:

M.I.C.C. cables will withstand high temperatures in service and are impervious to water and oil.

Being inorganic, m.i.c.c. cables are non-ageing and if properly installed will have an exceedingly long life.

There are only two grades of M.I. cable, 660 V and 440 V.

The cables can be supplied with single conductors in sizes equivalent to standard conductors up to 0·2 sq in.; the length varies with the size of conductor and is 750 yd for the smallest cable and 68 yd for 0·2 sq in. copper section. It is also made in 2-, 3-, 4- and 7-core cable with conductor sizes up to 0·03 sq in. For larger sizes, several single-core cables can be used in parallel per phase.

Suitable sealing devices are supplied to ensure that moisture does not penetrate the dielectric from the ends of the cable. A cable jointer is not required since an electrician can deal with the sealing operations. It is claimed that moisture will not normally penetrate more than 10 in. from the end of an unsealed cable and that it will usually take more than a year to get as far as 6 in.

Although copper has an immense resistance to corrosion, certain conditions still have an adverse effect on m.i. cable. M.I. cables can now be obtained with a seamless extruded p.v.c. sheath over the copper as a protection against corrosion.

British Standard 3207:Part 1, 1960, for m.i.c.c. cables has now been issued. This part of the standard deals with copper-sheathed cables with compressed powdered mineral insulation and copper conductors. Similar cable with other types of conductor, insulation and sheaths are under consideration. Owing to the excellent heat-resisting properties of the insulation, the current rating for this type of cable is very high and in many instances, where long runs are concerned, the current-carrying capacity of m.i.c.c. cable installations is determined by the permissible voltage drop.

Multicore m.i.c.c. cables are not manufactured with copper sections larger than 0·03 sq in. and, therefore, when larger copper sizes are deemed necessary, two or more single-core cables (which are made in conductor sizes up to 0·2 sq in.) must be used in parallel. Ratings for m.i.c.c. cables are given in Table 23 of the thirteenth edition of the IEE Regulations and the figures given are for the guidance of cable users, but in service the current rating of a m.i.c.c. cable (not subject to voltage drop) is limited only by the temperature at which it is safe to run the sheath in the particular position in which it is used.

A British Standard specification for terminals for mineral-insulated cables is now being prepared.

Corrugated Copper-sheathed Cable

Recently, there has appeared in Germany an extremely unusual application of copper to low-voltage cables in the form of a welded corrugated sheath. This performs the threefold purpose of excluding moisture, protecting against damage and forming a neutral conductor. The development is restricted to the low voltage system of the concentric neutral type which is proving very popular on the Continent. The cable combines economy of production and use of material with the easy and reliable jointing technique and freedom from corrosion hazards characteristic of copper. Increase in the demand for this type of cable, which, for the present, is confined to Germany, has been said to be spectacular in the last 12 months.

A recent paper[22] deals with the development of a cable sheath made of corrugated copper tube; manufacture of the cable, its behaviour in service and with short-circuits to earth are also described.

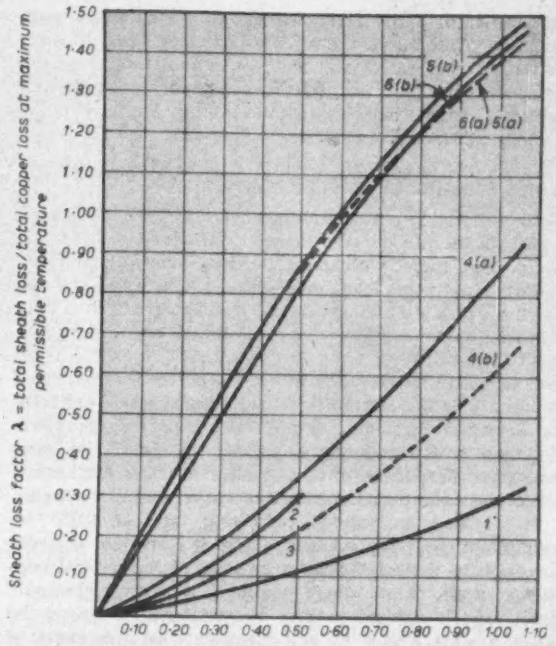

Fig. 10. Aluminium sheath loss factors of cables conforming to BS480: 1954 (ERA Report F/T 187)

1. Three-core belted 1·1 kV (80°C). 2. SA type cable, 22 kV (65°C). 3. Three-core screened, 22 kV (65°C). 4. Three single-core trefoil, touching, (a) 22 kV (65°C); (b) 1·1 kV (80°C). 5. Three single-core, trefoil duct, (a) 22 kV (65°C); (b) 1·1 kV (80°C). 6. Three single-core, flat formation in air, 3½ in. axial spacing, (a) 22 kV (65°C); (b) 1·1 kV (80°C)

Current-carrying Capacity of Power Cables

The replacement of lead sheaths by aluminium sheaths does not modify the heat flow conditions within the cable or significantly affect the sheath emissivity constant. For the given temperature rise, current-carrying capacity is mainly influenced by the higher conductivity of the aluminium sheath causing heavier sheath losses. Whilst these have little effect on the current ratings of twin and multicore cables, they become important in single-core cables to an extent that the elimination of sheath circulating currents by cross bonding or other methods is imperative (Fig. 10). Rating factors have been calculated for aluminium-sheathed cables with aluminium or copper conductors.[23] They are based on the ratings for copper conductor lead-sheathed cables given in ERA Report F/T.183 and assume the same maximum conductor temperature as standarised for paper- and varnished-cambric-insulated lead-sheathed cables, except that unarmoured cables in ducts, when aluminium sheathed, operate at the same temperature as armoured cables pulled into ducts.

Short-circuit Current Rating

In short-circuit operation between phases, the current ratings established for lead-sheathed cables are applicable to aluminium-sheathed cables, only in a minority of cases does sheath conductivity become a significant factor under

phase-to-earth short-circuit conditions. The higher conductivity of aluminium gives conductivities equal to 80% and more of those of one conductor in multicore cable and 30% and more of that of the conductor in single-core cables. The mechanical strength of the sheath is added security under short-circuit conditions.

Solid Conductor Aluminium Cables

An interesting new development is the "Solidal" cable[24] based on the use of solid-shaped conductors of fully soft aluminium, thereby obtaining the maximum-compactness.

Each sector shaped conductor is insulated by an extruded p.v.c. insulation and the conductors for multicore cables are twisted together into cable formation with a right-hand lay, without any pre-twisting. The laid-up cores are then lapped with a clear p.v.c. tape to a thickness of 0·040 in. For the concentric neutral design, this conductor is formed by a single layer of aluminium wire or strip having a cross-section equal to that of one of the cores or a given proportion of it. The layer provides mechanical protection and at the same time acts as a neutral conductor.

It is usual to provide equalising tape of 0·005 in. aluminium foil applied with long lay in the opposite direction to that of the wires or strip of the neutral conductor itself. Also, where required, a barium-chromate linen tape is applied to give chemical protection to the wires against attack by soil electrolyte, in the event of damage to the outer sheath. An extruded black p.v.c. sheath is applied overall.

A concentric single-phase service cable has also been developed, which consists of a solid round centre conductor, p.v.c. insulation, with a concentric layer of round wires forming the neutral conductor.

"Solidal" cables are now being made in a range of sizes which, on the basis of resistance per 1,000 yds of cable, corresponds to those for stranded aluminium conductors as BS 2791:1956.

With the soft aluminium used, "Solidal" cables are recommended as suitable for withstanding all the standard bending tests required for insulated cables. It is also claimed that soldering of aluminium cable presents no difficulties to experienced jointers and that a compression jointing technique, which is faster than soldering, has been developed and that fittings can be supplied.

Summary

1. The use of copper continues to predominate over other metals in the electrical industry and this position is not likely to change unless the price position of copper changes relative to alternative metals or unless conditions arise which affect the supply position.

2. The continually fluctuating price of copper justifies careful and continuous assessment of the economic and technical merits of aluminium as a conductor and sheathing material. For certain applications, aluminium wire armouring is also used (e.g., the 330 kV OF cable for Kariba—refer *Electrical Review*[25] issue dated 8 January, 1960).

3. The merits of copper (and lead) are well known and exploited, but aluminium offers a decided advantage where strength and reduced weight are essential.

4. For the special requirement of gas-filled or oil-filled pressure cables the use of an aluminium sheath coupled with a high-grade protective covering (which can be tested electrically from time to time) offers an interesting competitor to the reinforced lead-sheathed construction—service experience with aluminium-sheathed and specially protected pressure cables is increasing. In view of the long service life required for e.h.v. buried cables the use of protected aluminium-sheathed cables laid direct should be gradual, based on successful tests on the coverings and successful practical experience acquired.

Acknowledgment

The author wishes to thank Mr J. L. Egginton, chief transmission engineer, Central Electricity Generating Board, for permission to publish this series of articles.

(*Concluded*)

Correction. With reference to Part 1 of the above article in ELECTRICAL TIMES issue of 13 April, the author's attention has been drawn to the fact that since May, 1957, Algo "30" solder has been used, this being a cadmium-free solder having the following composition: Tin 50%, Lead 45% and Zinc 5%.

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23. ERA Report, F/T183: "Current Ratings for Paper Insulated Cables to BS 480:1954," and "Varnished Cambric Insulated Cables to BS 608:1956."
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I.E.E. ANNUAL REPORT

MEMBERSHIP of the IEE had reached 47,422 by the end of March. This statistic opens the report of the IEE Council presented to the eighty-ninth a.g.m. of the Institution. The report covers a year marked by publication of the report of the special advisory committee of the Council set up after the special general meetings of 1959, and by completion of work on the Institution building, which had been in progress since 1958. Total cost of the reconstruction is said to be "very close" to the estimated figure of £400,000 given at the 1959 a.g.m.

The technical activities of the Institution, apart from the routine reading and publication of papers, has included preparation by the Wiring Regulations Committee of amendments to the thirteenth edition of the Wiring Regulations. These are concerned mainly with taking account of recent changes in British Standards, and early publication is expected. Also scheduled for publication soon is the new fourth edition of the Regulations for the Electrical Equipment of Ships.

The Institution is dealing with the drafting of several Codes of Practice, covering subjects such as earthing, maintenance of control gear, installation and maintenance of dust-tight equipment, climate proofing and cathodic protection.

In the education section of the report, it is noted that in 1960 the Higher National Diploma Course showed "a remarkable revival" with nearly double the number of candidates compared with the previous year. Entries for ONC and HNC final examinations continued to grow, the HNC figure being 3,753 entries with a 67% pass. Ordinary National Diploma, however, is noted as passing through a period of unpopularity.

The accounts of the Institution issued with the report show a total income of £238,533, with an excess of income over expenditure of just under £38,000. Management of the Institution took 5s 9½d/pound of income in 1960, a decrease of 1s compared with the previous year.

Increasing Efficiency in Electrical Laboratories

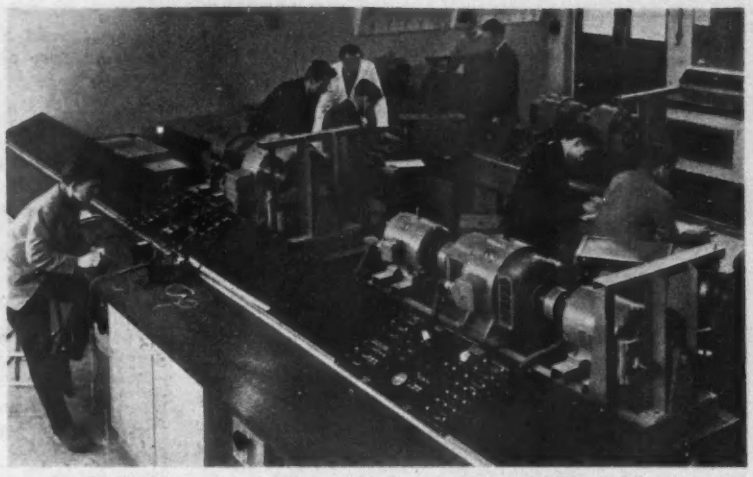


Fig. 1. Work in progress in Electrical Machines Laboratory, Mid-Herts College

IN the traditional arrangement of electrical engineering laboratories the student himself has to collect together all instruments and equipment for a particular experiment and connect these with leads, often of miscellaneous types. This results in a considerable waste of time, which is of particular importance to part-time and evening class students. In many instances more than half the time allowance for practical laboratory work is taken up in such preparatory work. Clearly there is room for improvement in the efficient utilisation of laboratories. The larger number of students presents Education Authorities with the choice of increasing efficiency or providing a larger number of colleges. When planning the electrical engineering laboratory for the new Mid-Herts College of Further Education at Welwyn Garden City, careful consideration was given to the arrangement of the equipment, with a view to giving greater operational utilisation and efficiency.

A laboratory layout was adopted in which the various experimental machine sets were mounted on concrete plinths at a height convenient for students to make speed measurements, adjustments to torque measuring brakes and visual examinations regarding commutation. The plinths carrying the machines were arranged in two lines down the laboratory and in front of each line an island bench, fitted with a continuous length of specially made enclosed trunking, faced with Traffolyte, supported the machine control panels. Each of these machine control panels was fitted with necessary switches and terminals for the incoming power supply and machine control gear. Ends of the machine windings were also brought out to terminals, with the necessary mimic diagrams provided. Control gear was fitted in accessible and visible positions beneath the front face of each bench. Provision was made on the bench surfaces for sufficient space for the setting up of instruments and small equipment for experiments, as shown in Fig. 1.

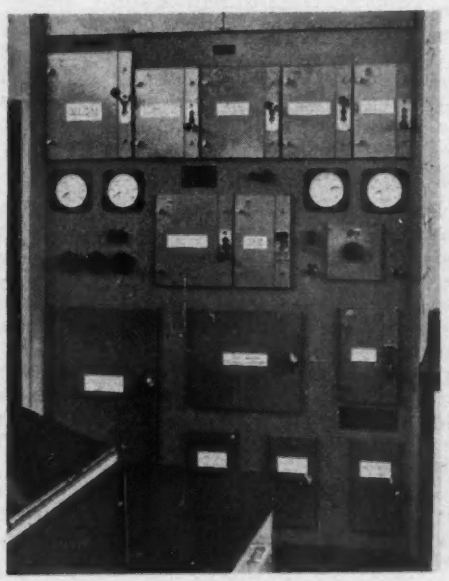


Fig. 2. Distribution switchboard for laboratories

Consequently, a student carrying out an experiment in this laboratory has the machine set in full view all the time. He can, by using standard connection cables fitted with spade ends, join the machine winding terminals to the power supply and the various instruments and items of control gear he has decided to use. This arrangement makes rapid connection possible, whilst ensuring that no permanent connections are built-in which the student should complete himself. The student is therefore left with the responsibility for connecting up the equipment intelligently.

In order to give the student first-hand acquaintance with the actual form of the equipment he is using in his experiment, all items of control gear can be easily opened up for inspection, are in full view of the student and not hidden within control panels or desks.

Around the outer walls of the machine laboratory and also in the electrical science laboratory of the College are further sections of similar continuous trunking. These carry Traffolyte front faces fitted with sets of supply terminals and are used for the distribution of supplies within the laboratory. Power supplies so provided are:

(i) Reduced voltage three-phase a.c. supply on 240 V phase-to-phase with neutral available, derived from a 25 kVA transformer.
(ii) 240 V d.c. two-wire supply from an 11 kW motor-generator.
(iii) 6 V stabilised d.c. from a rectifier equipment.
(iv) 240 V single-phase supplies brought out to 13 A socket-outlets.

The use of continuous trunking in the laboratory made the wiring easy. It also made possible the construction of the remainder of the machine control benches in wood

Fig. 3. Electrical Science Laboratories showing arrangement of supplies

instead of steel as is usually done, thus resulting in considerable savings. Supplies to the machines are by separate feeder from a main distribution switchboard of simple type, but the remaining supplies to bench power outlet points are by 7/·004 ring main.

The consultants decided to use miniature circuit-breakers for the control of supplies on the various bench outlet points and on the machine control panels. These are used both as switches and for protection, and have in this manner proved economical in cost. All circuits carrying these minature circuit-breakers are protected at the distribution switchboard by h.b.c. fuses.

A feature of the installation makes it possible to earth the positive or negative of the low voltage d.c. supply by means of a non-standard plug on the main distribution switchboard. It is also possible to earth the star point of the low voltage transformer from which three-phase supplies are derived by means of another non-standard plug of different size. It is therefore possible for the instructor to decide whether to work with or without an earthed supply for both low voltage d.c. and three-phase a.c.

The planning of this installation was by the electrical consultants, Peter Jay and Partners, with the contract department of Crompton Parkinson Ltd. The architects were Louis de Soissons, Peacock Hodges and Robertson. Crompton Parkinson supplied the main m.g. set, transformer and five experimental machine sets of different types with their control gear. Peppers of Woking Ltd. supplied the main distribution switchboard and specialist trunking. The wiring installation was carried out by Strand Electric Co. Ltd.

Mechanical Stress and Resistance to Discharge

THE study of the behaviour of electrical insulation under stress is endless, not only because factors affecting performance vary with the shape and design of components, ambient conditions, etc., but also because of the never-ending entry of new insulating materials into the field. Until the late 'thirties, practically all high-voltage research was confined to glass, ceramics and phenolic-resin laminates; today, the studies have to encompass a host of new synthetic materials, all of which are in wide usage, and many forms of reinforcement or filler. Most are available in a range of formulations; some are irradiated, others have various accelerators, plasticisers, fillers, any one of which will affect ultimate electrical performance.

About ten months ago the Electrical Research Association completed the second interim report* on a study of the Resistance of Sheet Insulation to Surface Discharges as a continuation of the earlier report, released in 1958, largely concerned with the determination of electrode arrangements to give consistent results. The present study has been carried out with rod and cylinder electrodes.

An earlier research in 1955 had shown that polystyrene in a state of mechanical strain has lower resistance to surface discharge than an unstrained specimen. The present report discloses that many glass and paper laminates also show lower surface discharge values if subjected to mechanical tension, but not to compression. As in previous experiments, it was necessary to circulate dry air over the surface during the test to remove moisture and oxides of nitrogen, which form semiconducting surface films. It was found that, on multi-electrode assemblies with electrical stress applied at several points at once, life is not affected by periodic interruptions of test, nor by voltage surges resulting from failure at any one electrode.

Effects of Frequency

A grade of linear polythene showed a life at 500 c/s three times to five times that at 50 c/s, but subsequent tests disclosed that the sample was variable in quality, which might be responsible for the phenomenon. This aspect is, therefore, being pursued further.

Another observation which could prove significant was that discharges, applied as pulses at stresses exceeding 2 MV/cm on polythene sheet, from the positive electrode were smaller and more numerous than from the negative, but that the latter are more destructive. The effect is less on "Melinex" (polyethylene terephthalate). Researches into the field of glass laminates indicated a need for investigating different finishes, percentages of hardeners, etc., before results could have any significance. Silicone glass laminates with a high phenyl content, giving greater adhesion to the glass fibres, are not readily penetrated by the discharges. Even here the differences between the products of one manufacturer and another on apparently the same grade showed need for closer manufacturing control.

The amine hardener in some epoxy laminates changes colour at elevated temperatures or in the presence of ozone and nitric oxides. Disturbing though this might seem to the investigator, however, it does not signify any reduction in discharge resistance.

Melamine and Phenolic Laminates

Though the samples tested are too few for adequate comparison, it appears that the discharge resistance on melamine and phenolic laminates falls particularly rapidly with temperature. It also falls with mechanical stress on silicon glass, phenolic paper and phenolic-nylon-fabric laminates but, with epoxy E5 laminate, there is evidence that mechanical strain may improve discharge resistance.

Studying the effect of so-called anti-tracking varnishes on discharge resistance of phenolic laminates, the report discloses that the Admiralty grade phenolic anti-tracking varnish has no significant effect, but an alkyd varnish improves life considerably.

A host of small observations, none of which are yet suitable for design application, as the report is careful to mention, but which, nevertheless, make significant contribution to our knowledge of insulation under stress.

* Technical Report L/T394. Electrical Research Association. Price 18s.

Thermoelectric generation

NEW THERMIONIC GENERATOR SPONSORED BY N.R.D.C.

THERMOELECTRIC generators can broadly be divided into two groups; those in which the electron flow takes place in solid state bodies—thermopiles—and those in which it takes place in space—thermionic diodes. In both cases the flow is induced by a difference of temperature between the extremes of the device, the hot junction, or emitter, and the cold junction, or collector. As low efficiency devices they have been known and used for many years, but it is only in recent times that concentrated investigation into their possible use as direct thermoelectric generators has taken place. Both in Britain and abroad, large sums have been expended in a study of the methods by which direct conversion of heat into electrical energy could be encompassed with an efficiency comparable to that by known thermo-mechanical methods, a study which has been stimulated by applications latent in space exploration vehicles.

One of the British investigators, Prof D. Gabor, F.R.S., of the Imperial College of Science, has been studying a new type of thermionic generator and has been backed in his work by the National Research Development Corporation. In the NRDC April bulletin, just issued, a brief summary of the device in its present state of development is given, together with two diagrams, reproduced below.

Basic Principle

The basic principle is due to Langmuir who, 40 years ago, proved that a heated emitter in vacuum will deliver electrons to a collector electrode providing only that the latter is kept cool by some process. But he only achieved a small current flow at low efficiency. Recently, it was realised that the efficiency might be raised if the negative space charge produced by the cloud of electrons in the vicinity of the cathode could be removed or neutralised by the introduction of positive ions. Caesium has always been an obvious choice of research workers for this function but, unfortunately, it is very active chemically, which makes manufacture difficult. Prof Gabor's solution is to use argon or an argon-mercury mixture at low pressure as the ion source.

Fig. 1 shows the discharge process in principle. The main discharge occurs between the heated emitter and the collector electrode, the voltage drop in the main discharge space being low—of the order of a fraction of 1 V. No ionisation takes place in this area, which remains dark. An auxiliary discharge between an auxiliary anode and a gauze screen produces a stream of positive ions, some of which beam through the gauze apertures into the cathode collector space, so neutralising the space charge. Some of the electrons pass through the gauze in the reverse direction as fine electron beamlets, but the focusing properties in the design return a large fraction back again.

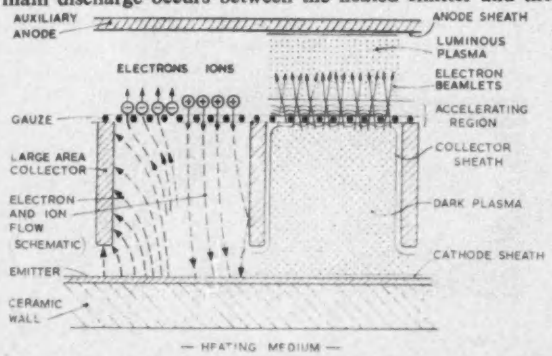


Fig. 1. Principle of the Gabor thermionic generator

Fig. 2 illustrates the general construction. To obtain a large collector area, the collector electrode is in cellular form and is of metal with high heat conductance supported on metal bars to conduct the heat away to the coolant surrounding the terminal plate. The gap between emitter area and the collector is about 1 mm and the cells are 3 mm to 5 mm across. The gauze is above and in contact with the collector, the auxiliary anode, shaped to wind in and out of the cell structures, being supported above the gauze. The arrangement produces current densities of the order of 4 A/sq cm and, to minimise the fall-off which naturally accompanies a scaling-up of the device, the emitter area is divided into hexagonal units, each with its own cathode lead also acting as a mechanical support for the ceramic envelope.

The work function of the collector is important and, with emitter temperatures in the 1,500°C to 1,800°C range and work functions of 2 V to 3 V, efficiencies of 20% to 30%, with power densities of 4 kW/sq ft to 6 kW/sq ft, should be achieved.

A.C. Generation

One important aspect of Prof Gabor's device is that it permits the generation of a.c. By breaking the auxiliary discharge circuit, the device becomes non-conducting. With two such devices connected in push-pull across an output transformer, a.c. can be generated, though at some loss in efficiency.

There are, of course, many obstacles to overcome before the device reaches practicable application, but the line of development is no less promising than that so far disclosed in other countries.

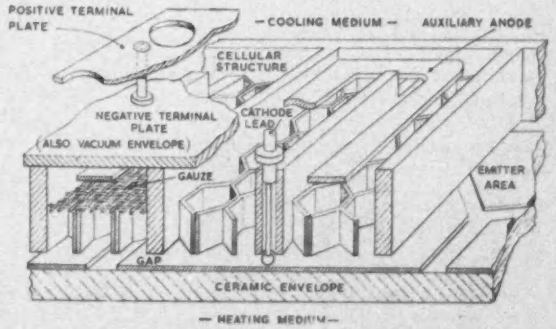


Fig. 2. Constructional features of the new device

new products and appliances

Thermotank sell Westinghouse conditioners

UNDER a recently announced agreement Hall-Thermotank are to market American Westinghouse air-conditioning equipment in this country. The equipment is being sold by the International Products Division of Thermotank. Among Westinghouse packaged units now available are self-contained air-conditioners, either air or water cooled with capacities ranging from 33,000 B.Th.U's/hr to 550,000 B.Th.U's/hr. Units are fitted with compressors and where heating is required they can be supplied with an optional choice of resistance heating elements, steam heating coils or hot water heating coils. A further range of Westinghouse equipment to be introduced is the AU series of air conditioners designed for situations where the condensing section is located separately from the air handling unit. *Thermotank Ltd., International Products Division, Rochester Row, S.W.1.*

Three-phase home laundry

DUE to be launched in early June, the new Bendix home laundry unit washes and dries in the same cabinet. Called "Triomatic," it is claimed to automatically fulfil all three functions of home laundry equipment. First, wash and triple-rinse programme; then spin-drying; and finally heat drying at three different heats. A cooling tumble action after any of the pre-set operations precedes final automatic switch-off. *Bendix Home Appliances Ltd., Oxford St, W.1.*

500 W radiant fire

AN addition to the Thermodare "Warmwave" range is an attractively designed portable model with 500 W loading. Suitable for a.c. or d.c. standard voltages, "Warmwave 50" is finished in beech white and dove grey. It is 16½ in. long, 6½ in. deep by 8 in. high and the list price is £3 17s 4d, plus 14s 2d purchase tax. Others in this range are the "Warmwave 77" and "Warmwave 100" models for wall mounting. The infra-red elements in these heaters operate on the three micron waveband and are protected by quartz tubes. Control is by means of a built-in pull cord switch and they are claimed to be easily adjustable. "Warmwave 77," loaded to 750 W, sells at £5 7s 10d and the "Warmwave 100," a 1 kW model, is priced at £5 15s 4d. *Thermodare (Great Britain) Ltd., York Mansion, Petty France, S.W.1.*

Thermodare's portable 500 W infra-red fire, "Warmwave 50"

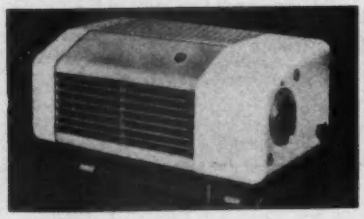
Cabinet for frozen food

PROVIDING increased storage within modest overall dimensions, Prestcold's latest open food cabinet, OFC 382, is available in two models, "Retailer Major" and "Vender Major." They are basically the same in design and equipped with the Super Presmatic sealed refrigeration system incorporating a capillary tube refrigerant metering device. Temperature control is by a preset adjustable thermostat and a feature of this freezer is the self-resetting overload device which protects the unit from damage by overloading. "Retailer Major" differs from its counterpart in that it has an illuminated canopy set above an angled mirror which reflects cabinet contents. Both models have similar dimensions and cubic capacity. Cabinets will hold 12·3 cu ft of packaged frozen food and occupy a floor space of 51½ in. by 28½ in. "Vender Major" costs £152 10s and the "Retailer" model £7 more, both prices including delivery and installation. *Prestcold Divn, Pressed Steel Co. Ltd., Swansea, Glam.*

Tangential heater from Berry's

ANOTHER contestant in the tangential fan heater market comes from Berry's who are to launch their TF2 in the early autumn. It is claimed to be able to project a jet of air 15 ft before dissipation and either hot, warm or cold air can be selected by a rotary switch. A safety cut-out switches off if the fan heater is accidentally covered and a pilot light indicates when current is connected. Loaded to 2 kW, the heater measures 12½ in. by 5½ in. by 7 in. Casings are finished in cream and mushroom with a chromium bar and black switch. Including purchase tax the price will be £11 19s 6d. *Berry's Electric Magicoal Ltd., Touchbutton Hse, Newman St, W.1.*

New tangential fan heater by Berry's comes on the market in the autumn



Rechargeable torch batteries

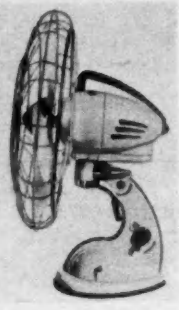
A STANDARD 2·5 V torch battery which can be recharged is the "Etromat," made by Electronics and Automation. It is recharged by simply plugging into a two-pin a.c. 240 V socket-outlet and left overnight or for any convenient period. With normal intermittent use the battery is claimed to give several weeks' service before recharging is necessary. The battery is light and compact as well as completely shockproof and is said to eliminate torch corrosion. Other sizes in the range are 3·5 V, 5 V and 6 V rating, and all are available with either British, Continental or American charging terminals. *Electronics and Automation (London) Ltd., Maxwell Hse, Arundel St, W.C.2.*

Packaged air conditioning

TWO self-contained air-conditioning units, now being marketed, the 41E and 41EE, have capacities of from 20 tons to 50 tons of refrigeration and are intended for large commercial and industrial applications. They provide cooling, heating, dehumidifying, filtering and circulation from a compact unit which may have either water-cooled condensers or Carlyle air-cooled evaporative condensers. *Carlyle Air Conditioning and Refrigeration Ltd., 1 King St, St. James's, S.W.1.*

Redesigned fans

THE existing range of Veritys' desk and wall fans has recently been replaced by a new series, the "Essex." The series is available in 12 in. and 14 in. sizes for desk, pedestal or wall mounting. The new model of contemporary design is claimed to have an improved performance over its predecessor, the 12 in. model, having an output of 1,400 c.f.m. Three speeds are provided by a rotary selector switch and another control provides either static or oscillating movement. Prices in this range vary between £12 2s 6d and £14 17s 1d, including purchase tax. *Veritys (Fans) Ltd., Essex Rd, N.1.*



Contemporary styled fan from Veritys with three-speed control can be static or oscillating

Twin filament indicator lamp

AN addition to the Thorn range of indicator lamps is a twin filament warning indicator cap suitable for any of the standard ½ in. thread lampholder bases in the series. Two separate filaments are embedded in a translucent cap with an opaque divider placed between them. Both filaments evenly illuminate the cap and if one fails the other will remain illuminated for warning purposes. Cap colours are available in red, green, amber and ivory.

The company have made a new addition to their miniature sealed glass lampholders. This is a waterproof pressure-resistant design for heavy duty use such as military equipment. The shell of the lampholder is insulated from both contacts and designed for single aperture mounting. *Thorn Electrical Industries Ltd., Thorn House, Upper St Martin's La, W.C.2.*

Floor and ceiling-heating systems

A SYSTEM of electrical heating, which is claimed to be suitable for floors and ceilings, has been launched by Triplan. Simplex heating cables are assembled on flexible, non-inflammable formers in the ceiling-heating system. These cables are laid between joists and covered with thermal insulation material. In existing buildings no structural alterations are involved and it is said that installation can be carried out at a relatively low cost/sq ft. For floors, the "Quick-response" system is laid on insulation on top of floorboards and provides heating for existing or new houses and bungalows. Loading is up to 15 W/sq ft and installation costs vary according to surface finish. *Triplan Thermal Acoustics Ltd., Cromford Hse, Cromford Court, Manchester 4.*

Inverters for d.c./a.c.

DEVELOPED for fluorescent lighting, the first of a range of the three d.c./a.c. inverters now available was originally designed for use on BTC coaches. The unit is rated 230 V a.c. 1,200 c/s output at 240 W and the input is suitable for 110 V d.c. The second unit is rated 230 V a.c. 8 kc/s, 40 W, output and is intended for an input of 24 V d.c. Here again, fluorescent lighting is a possible application and the low voltage supply can be derived from a commercial vehicle or tractor battery. The third unit is rated 230 V 50 c/s, 100 W, and is also suitable for a 24 V d.c. input. These three units now available will be supplemented by further units now being developed. *AEI Ltd., Electronics Apparatus Division, New Parks, Leicester.*

Cheapest hand food mixer?

CLAIMED to be the most inexpensive hand food mixer and liquidiser, "Chefette," by Kenwood, costs £11 0s 6d including purchase tax. It is said to be able to mix, blend, mash and prepare raw vegetables; coffee grinding is another of its attributes. A feature of this appliance is a wall bracket by which the mixer can be suspended below the liquidiser. It has three-speed control and operates on a.c. *Kenwood Manufacturing (Woking) Ltd., Woking, Surrey.*

Industrial electrostatic dust-filter

WORKING on the electrostatic ionisation principle, the "Industrion Electrical Air Filter" is intended for operation under arduous industrial conditions. Of robust construction it features a dust-collecting cell of heavy-gauge aluminium with a specially strengthened ionising section. The heavy-duty filter is fitted with multi-cell pre-collectors to arrest any unusually large particles entering the extraction orifice. The filter itself comprises an ionising section followed by one or more collecting plate sections, the combination being chosen to suit particular industrial environments. Cleaning of the filter is achieved by vibration, collected dust being dislodged to fall into a storage hopper. Advantage claimed for this cleaning system is that it can be applied frequently without undue interruption to dust collection and effectively enables a high dust burden to be handled. *W. C. Holmes and Co. Ltd., Turnbridge, Huddersfield.*

New fires from Morphy's

TWO new fires from Morphy-Richards which will be marketed in the early autumn are an infra-red heater and a combined infra-red plus convection heater. The free-standing infra-red fire will be available in October and joins the wall mounted model. It has a loading of 1 kW and is fitted with carrying handle and overall fire guard. Provisional price is announced as being approximately £4 19s 6d. Deliveries of the other new heater "Radiant Derwent" are scheduled for early September. It is a further development of the "Derwent" range of convectors and combines a 750 W infra-red element with a 2 kW thermostatically controlled convection unit. A separate switch is fitted for the infra-red element and the heater can be used as either a free-standing or wall mounted model. *Morphy-Richards (Cray) Ltd., Conduit St, W.1.*

Automatic stator winding machine

A WIDE range of stator winding configurations for electrical machines can be handled by the Lincoln automatic winder. Now available in this country, the equipment has been established for some years in the United States where production figures quoted for it have been in the region of 470 stators wound in a day. Actual winding time for a typical stator is said to be 38 sec, time to remove the finished stator and start winding the next one being between seven sec and eight sec. The machine can wind both enamel- and cotton-covered wires. *Kingdom Engineering Co. Ltd., Sharrocks St, Wolverhampton.*

TRADE PUBLICATIONS

A.E.I. — Publication combining three articles by engineers of A.E.I. Motor and Control Gear Divn. on electric drives in the paper industry. A.E.I., Rugby.

HEAD WRIGHTSON.—Two leaflets, one giving details of a Series 1 cooling tower and the other dealing with treatment of water and effluent. Head Wrightson and Co. Ltd., Buckingham Gate, S.W.1.

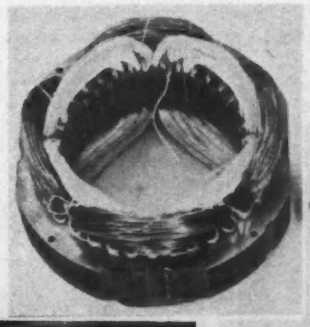
W. C. HOLMES.—Publications 86 and 88, entitled "Industrial Electrical Air Filters" and "Products of the Holmes Organisation." W. C. Holmes and Co. Ltd., Turnbridge, Huddersfield.

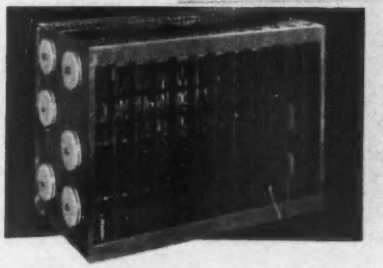
C. A. E. C. HOWARD.—Illustrated leaflet giving details of tipper for unloading railway wagons. C. A. E. C. Howard Ltd., St. John's Wks, Bedford.

KENT.—Diagrammatic leaflets detailing "Commander" air operated receiving instruments and open-channel flow-measuring instruments. Geo. Kent Ltd., Luton, Beds.

PYRONTEX.—Illustrated booklet produced in silver jubilee year giving specifications of range of cables. Pyrontex Ltd., Hebburn-on-Tyne.

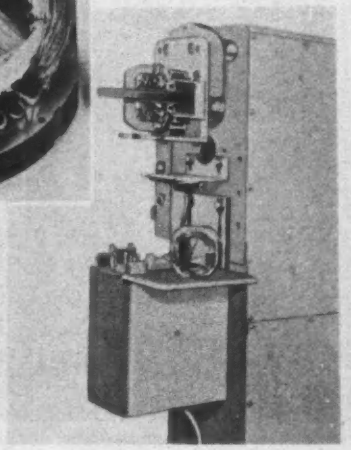
WALMORE ELECTRONICS. — Leaflets describing cold cathode thyratrons for high current made by Cerberus Elektronik of Switzerland. Walmore Electronics Ltd., Bettertos St, W.C.2.





Below: "Industrion" heavy-duty electrostatic dust-filter for arduous industrial conditions

Lincoln automatic stator winder, below, with example of coil configuration it can handle, top left



Wire-stripping tool

RECENTLY announced is the model WS/S stripping tool for plastics-insulated wire. Incorporating a heating element, the tool is said to remove insulation without damage to underlying conductor. *"Lyteze" Products Ltd., 90 Church Rd, Brightlingsea, Essex.*

Silent contactors

FEATURE of a new range of a.c. and d.c. vertical lift mains contactors for general industrial, commercial or domestic applications is virtually silent operation. This has been achieved by the use of rubber mounting between contactor and case, the latter being of pressed steel construction with knockout entries. Rated from 20 A to 200 A a.c. and up to 40 A d.c., contacts are of the double-break pattern, silver-faced, and said to be easily replaceable. Life tests carried out on the unit have shown it to be capable of at least five million operations without performance being affected. The contactors are said to be particularly suited for controlling special tariff lighting and heating loads. *The General Electric Co. Ltd., Four Ashes, Wolverhampton.*

Redesigned bimetal line-tap

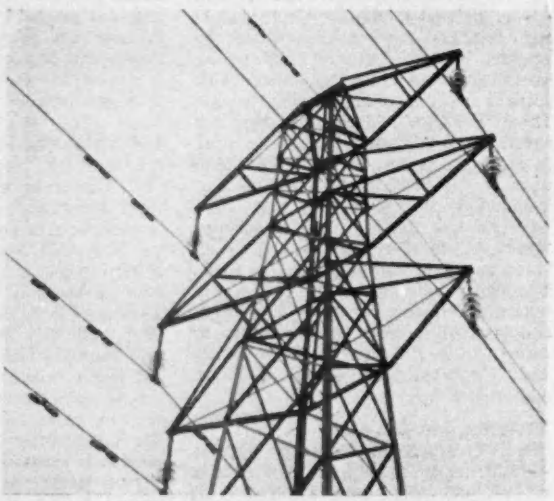
BY replacing castings with forgings a new version of the "ALCU" aluminium/copper bimetal line-tap has been produced which is cheaper in price than the original and said to give improved performance. Two sizes are available, covering 0·240 in. to 0·558 in. dia aluminium mains conductor and 0·092 in. to 0·300 in. dia copper service conductor. Sizes of soft aluminium tubes for sheathing service conductor remain the same. *Aluminium Wire and Cable Co. Ltd., 2 St. James's Sq. S.W.1.*

Top: "ALCU" bimetal line-tap. Bottom: "Lyteze" wire stripping tool

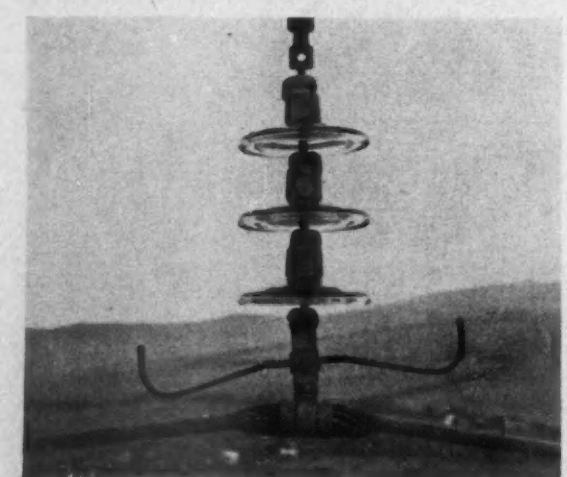
"Silmalec" Conductor for Tower Lines

BREAKING away from conventional practice, the Southern Electricity Board have favoured "Silmalec" aluminium alloy conductor for second circuit stringing an existing double-circuit 33 kV tower line. Erected in 1950 with a single 37/·102 ACSR circuit, the 7·6 mile line reinforces power supplies to Weymouth from Dorchester Grid substation. The use of "Silmalec" gives the second circuit a transmission capacity over 10% higher than that of the original ACSR circuit.

Although "Silmalec," manufactured by the Aluminium Wire and Cable Co., has been used abroad as an alternative to ACSR for main o.h. transmission lines, its previous application by the SEB has been confined to pole-supported distribution lines having relatively short-span lengths. The Dorchester-Weymouth tower line, however, has a normal span of 800 ft and includes a maximum span of 1,478 ft. The particular characteristics of "Silmalec" enabled the second circuit to be strung with 19/·148 conductor, equivalent to 0·175 sq in. copper section (compared with 0·15 sq in. copper equivalent for the original ACSR) without infringing existing clearances or exceeding maximum specified tower loadings. At a maximum working tension of 6,200 lb, well within the 7,000 lb loading allowed in the tower design, 19/·148 "Silmalec" has a maximum sag almost exactly the same as the original ACSR. Furthermore, overall diameter of the new conductor is not significantly greater, enabling wind loads to be kept below design limits.



Tower line with "Silmalec" second circuit. Note absence of dampers on right hand



Armour grip suspension fitting used for "Silmalec" conductor

No Dampers

Distinguishing feature of the second circuit is the adoption of "armour grip" suspension fittings to support the "Silmalec" at intermediate tower positions. Besides providing an extremely flexible means of support, these fittings also give the equivalent of armour rod protection against conductor vibration. Attenuation of vibration due to this type of suspension has been found so effective that the usual Stockbridge dampers are dispensed with.

While the primary object of second circuit stringing was supply reinforcement, it affords an excellent opportunity for long-term comparison of "Silmalec" using armour grip fittings, as against a standard ACSR circuit with vibration dampers.

STANDARDISATION PROGRESS

BRITISH STANDARDS . . . INTERNATIONAL RECOMMENDATIONS . . . INDUSTRY CODES

AMERICAN standards for circuit-breakers have for long presented some difficulty to British exporters because of the different basis for short-circuit rating adopted. Changes in the method of rating are now proposed in a series of American Standards Association standards. These are in their final stages of preparation, and were described by Mr R. C. Van Sickle (Westinghouse Electric Corporation) at the recent 23rd annual meeting of the American Power Conference.

Principal object of the revision of the standards is "to improve the method of rating the ability of a breaker to withstand and switch short-circuit currents." At present, an American standard defines interrupting ability as the r.m.s. value of the total current: it is the same for both symmetrical and asymmetrical currents. It is proposed in future, for circuit-breakers whose contacts can separate in less than four cycles after the start of a short-circuit (60 c/s operation is assumed), that the required asymmetrical interrupting capability shall be higher than the symmetrical. The symmetrical interrupting capability is retained as the fundamental rating and designated the "rated short-circuit current." This change will come closer to British practice.

If the proposal is accepted, the required asymmetrical interrupting capability of breakers having five-cycle interrupting time will probably be raised by about 5% and the required symmetrical capability reduced by the same amount. For circuit-breakers operating in three cycles the changes will be about ±9%.

In connection with these changes, rated voltage is now to be the maximum design voltage permissible in the circuit-breaker, rather than nominal system voltage, and rated short-circuit current at the maximum voltage will be the basis of testing.

In the present American standard, rated short-circuit current has to be carried for four seconds. This is thought somewhat unrealistic today, and the time is to be reduced to three seconds. A make-carry current-break test cycle is to be written into the standard. It is suggested that a tripping delay of one or two seconds should apply for 115 kV and higher voltage breakers and two seconds for 69 kV and below. Circuit-breakers will be required to close and latch-in at currents up to 1·6 times maximum symmetrical breaking capacity. The effect is to raise the present requirements by 60% and increase electromagnetic forces involved by 156%. Such an alteration is thought likely to require changes in circuit-breaker design.

Amongst other changes, the proposed standard will introduce chopped wave impulse tests and a statement of the number of operations to be expected from a breaker in various types of use. Permissible temperature rises, when rated current is being carried, are being revised to take into account new materials being used in circuit-breakers. It is also hoped to include figures for "rated transient recovery voltage" since this can determine to a considerable extent how great a current can be interrupted.

Careful Handling

INTERNATIONAL standardisation of pictorial markings for packages is being investigated by an International Standards Organisation committee which started work this year. Apart from markings to indicate that the goods within a package are dangerous themselves, symbols have been provisionally agreed for: Fragile. Handle with care. Use no hooks. Do not puncture. This way up. Keep cool. Stow away from boilers. Sling here. Keep dry. Heavy weight this end.

LAMPS FOR N.C.B.

TUNGSTEN filament lamps for NCB use are the subject of NCB specification 241/1961. For general service use, lamps from 25 W to 150 W rating may be internally frosted or clear; from 300 W to 1,500 W, clear lamps only are specified. Lamps are required to be to BS 161. Lamps for a number of special purposes are also covered by the standard; these have to comply with BS 555.

Capacitors for Railway Signalling

IT has been the practice in the past for each region of British Railways to draw up its own specification when ordering capacitors for track signalling applications. Now BS 3347:1961, *Capacitors for railway signalling track circuits*, has been prepared at the request of the British Transport Commission to make this unnecessary. The specification applies to fixed and adjustable capacitors for use on either electrified or other railways as current limiting and phasing impedances in such circuits. Capacitors for this service have to be suitable for use in conditions of severe vibration, because of the close proximity of the railway tracks. Seven ratings of capacitors are specified, from 6·2 microfarad to 20 microfarad, and the standard also deals with dimensions and tolerances. Type and routine tests are set out in the standard, the latter covering value of capacitance, a heat test, a voltage withstand test and insulation test.

CODES OF PRACTICE REVISIONS

WORK on a number of electrical Codes of Practice is noted in the annual report of the IEE for 1960-61. Most important is the proposal to combine CP 321:Electrical Installations—General and CP 321.101:Electrical Wiring Systems into a single Code of Practice for electrical installations.

Other Codes undergoing partial or complete revision include those on installation and maintenance of electrical equipment; electric lighting in schools; protection of buildings against lightning; and installation and maintenance of flameproof and intrinsically safe equipment. Codes on fire alarms and sound distribution systems are also receiving attention, together with those on radio interference caused by i.c. engines, street lighting and the use of electronic valves.

Several new Codes are in the drafting stage. Amongst them is that on earthing, work on which has been proceeding for some years now. Others are maintenance of control gear, installation and maintenance of dust-tight equipment and climate-proofing for electrical equipment. A Code is promised of electrical equipment for industrial machines, on radio interference in aircraft, on the use of transistors and on cathodic protection.

New B.S.I. Work

BSI has started work on a standard for mechanical balancing of rotating machinery. In the first instance, attention is being given to marine rotating machinery, to balancing machines and to the terminology of the subject. A standard method of testing resistance of fabrics to water absorption is being drawn up, and another stating methods of calculation to be used for determining thermal transmission through building structures, a subject much in the news in connection with electrical heating. Centralised domestic hot water supplies are currently the subject of Code of Practice CP 342 and this is to be revised. Another revision concerns BS 709 on testing electric arc welds in steel. This revision is being undertaken to provide a standard work on the mechanical testing of weld joints and weld metal in most types of steel. It is hoped that as a result the need for a section on testing in many other welding standards will be eliminated.

News of the Week

No Upturn in Appliance Sales

But immersion heaters maintain their advance

APPLIANCE sales are still lagging behind the general level of consumer expenditure, judging by the latest figures from the area boards. Whereas retail sales as a whole were 7% higher in March than a year earlier, with food and clothing in the vanguard, sales in service centres throughout the country were still below the level of a year ago, except for immersion heaters, which have been selling particularly strongly for the past six months. The next best performers were cookers, with sales nearly equal to March, 1960, and 5,617 higher than in February last.

Clothes dryers showed the usual seasonal downturn, with March turnover only a half of February's. For the same reason, refrigerators rose by 50%, but this did not match the upsurge of the previous year, when the credit boom was at its height. The refrigerator turnover of area boards in March amounted to one-tenth of UK manufacturers' deliveries to the home market in that month.

Appliance sales by area boards	Sales in month ended 31 Mar., 1961		Sales in 12 months ended 31 Mar., 1961	
	Total	% change over corresponding month of 1960	Total	% change over preceding 12 months
Cookers ...	32,260	− 1.3	339,976	− 1.4
Water Heaters:				
Immersion	19,364	+22.0	199,511	+ 3.0
Storage ...	5,887	−18.4	65,462	+ 1.3
Washboilers	4,933	− 9.1	55,145	−15.7
Washing Machines ...	9,124	−24.7	101,550	−37.3
Refrigerators	9,842	− 0.7	142,459	−17.4
Clothes Dryers ...	2,361	−39.8	50,773	not avail.

Nuclear Exchange with Russia

EXCHANGES of visits between British and Russian engineers and scientists working in the nuclear energy field are provided for in an agreement signed last week. The agreement is between the UKAEA and the USSR State Committee for Atomic Energy Utilisation. Besides visits to nuclear installations, there is to be reciprocal exchange of unclassified reports on uses of nuclear energy.

In the first instance, the fields of nuclear development to which the agreement will apply will be: nuclear physics; solid state physics; basic radiation chemistry; inorganic chemistry; research on isotopes and their application; plasma physics; high energy physics; reactor physics; and experimental fast reactors.

Investigating the Breakdown

WHAT caused the extensive supply breakdown in the South East of England last week is being investigated by a special committee of inquiry headed by Mr L. Rotherham, CEGB member. Announcing that the CEGB had set up the committee, the Minister of Power said that technical aspects of the breakdown were complicated and that the full investigation would take some time. Meanwhile, as a precautionary measure, all lines and cables which had been taken out of service for routine maintenance had been temporarily restored to use, in order to give the greatest possible security of supply until investigations were complete.

Besides Mr Rotherham, the committee consists of Messrs J. G. Bentley (system operation engineer, Eastern Division), P. W. Cash (system planning engineer, CEGB), E. C. Scott (system operations engineer, CEGB) and L. W. Stretton (controller, London Division).

Smoke Control Areas

WHAT fuels are used in domestic premises in 60 smoke control areas in England and Wales is being determined in a survey organised by the Government. This was stated in a written Parliamentary reply last week. Results should be available later this year. The Parliamentary answer dealt with shortage of smokeless fuels which has caused difficulties in some areas. The difficulty mainly concerns smokeless fuels for burning on open fires.

NEW NORTH & SOUTH SCOTLAND LINK

A £40,000 contract for 132 kV cables at Kincardine generating station has been awarded to AEI Ltd. by the South of Scotland Electricity Board. This involves the supply and installation by AEI Construction (Cables and Lines) Division of two 132 kV circuits of six single-core oil-filled cables between 240 MVA 275/132 kV supergrid interbus transformers in a new 275 kV substation and an adjacent 132 kV substation. Three 132 kV single-core oil-filled cables are to be laid between the 132 kV substation and the termination of a 275 kV overhead line. This line, now under construction for initial operation at 132 kV, will link with the North of Scotland Hydro-Electric Board's, near Abernethy. The contract also includes the supply and installation of approximately 7,400 yd of l.v. power, multicore and telephone cables associated with the new 275 kV substation.

Trawsfynydd Costs

TOTAL cost of Trawsfynydd nuclear power station, including the provision of the initial charge of nuclear fuel, is expected to be £75 million, MP's were told by the Parliamentary Secretary, Ministry of Power, last week. Trawsfynydd is being built by Atomic Power Constructions Ltd. and has a net electrical output of 500 MW. Previously, the cost of construction (i.e., excluding the initial fuel charge) has been stated as "more than £50 million." Unofficial estimates have placed it at between £51 million and £54 million. The two reactors at the station will require a total fuel charge of 570 tons of natural uranium.

REYROLLE IN AUSTRALIA

REYROLLE switchgear is soon to be manufactured in Australia. This follows the signing of agreements by A. Reyrolle and Co. Ltd. and Oliver J. Nilsen (Australia) Ltd. providing for collaboration in the manufacture of h.v. switchgear and ancillary equipment in Australia (we reported on 27 April that Reyrolle personnel were going to Melbourne for this purpose). A new company is to be formed with the title of Reyrolle Nilsen (Australia) Pty. Ltd., with an authorised capital of £500,000 and registered office at 45 Bourke St, Melbourne. The first directors are: Mr Oliver J. Nilsen (chairman) and Mr O. V. A. Nilsen (representing Nilsen interests), Mr J. Bennett and Mr G. Robinson (representing Reyrolle interests) with Mr E. L. Cottrell as secretary.

A factory is to be set up at Melbourne, staffed with a nucleus of Hebburn trained personnel, where, in the first stages, h.v. switchgear will be part-manufactured and assembled. Nilsen's already have factories in Victoria and South Australia where they make l.v. switch- and fusegear, motor control equipment, transformers, switchboards and cubicles, and electrical appliances.

Earlier this year Reyrolle's also acquired the capital of William Begg and Sons Pty., of Melbourne, who had represented them in Victoria and Tasmania for 30 years.

25% More Power from Calder

ELECTRIC power output from the Calder Hall and Chapelcross nuclear power stations of the UKAEA will soon be 25% above design figures. This has been made possible by considerably improved heat output from the reactors obtained by slight modifications, and by reblading of the associated turbines to enable them to handle more steam.

Operating experience on the reactors showed an advance in heat output which had made it worth while reblading the turbines. Originally, each of the four Calder Hall reactors was designed for 180 MW heat output, from which it was hoped to generate up to 21 MW on each of two turbo-alternators per reactor. Design changes enabled the last three of the four Chapelcross reactors to achieve a marginally better heat output.

Experience since the first Calder reactor began operation in 1956 has enabled heat output to be stepped up first of all to 215 MW and then to 225 MW. In the absence of reblading this meant that considerable quantities of surplus steam had to be dumped to condensers. So far, two turbines at Chapelcross and one at Calder Hall have come on load after reblading and have successfully generated 27 MW, 28% above their original rating.

Transporting Electrical Machines

ELECTRICAL machines weighing 200 tons can be moved by road from Trafford Pk, Manchester, Stafford, Hollinwood and Birmingham to large ports. From Rugby, the limit is 170 tons. This is stated by the Minister of Transport in a written Parliamentary reply published last week. He added that manufacturers of heavy electrical apparatus in the London area should also be able within the next few years to transport plant of about 200 tons net weight.

In his answer, the Minister goes on to speak of "close and willing co-operation" with the Ministry of Transport by BEAMA and the CEGB in dealing with what he calls "the difficult problem of the transport of heavy electrical plant."

LARGE CONTRACTS

A 1,000 kW back-pressure turbo-alternator set just ordered by the British United Shoe Machinery Co. Ltd. will incorporate an electrical load limiter controlling the set to export up to 50 kW to the public electricity supply when the steam load is in excess of the equivalent works electrical load. W. H. Allen Sons and Co. Ltd. are supplying the steam turbine which will drive an AEI alternator. W. H. Allen have also received an order from Glaxo Laboratories Ltd. for a 1,230 b.h.p. turbine to drive an existing Reavell air compressor and provide process steam at an exhaust back-pressure of 27 p.s.i.g.

AS part of system reinforcement work at Stratton, near Swindon, AEI Construction (Cables and Lines) Division are installing two new 33 kV three-core oil-filled feeders along separate routes to the Southern Electricity Board's Park North substation. The latter is serving an LCC overspill housing development, and the Pressed Steel Co. Ltd. Value of the contracts is £37,000.

WILLIAM Boby and Co. Ltd. are to supply one deaerator for each of the four 500 MW turbo-alternators being built by the English Electric Co. Ltd.

Midlands Protest at Tariff Rise

AT its meeting last week the Midlands Electricity Consultative Council decided to make representations concerning the increase in domestic tariffs by the Midlands Electricity Board (reported in our 20 April issue). The Council is informing the Electricity Council that in its opinion, domestic consumers, particularly those making full use of the supply, are being required to carry too great a proportion of the increased charges. The Council would have liked to have had the opportunity of telling the Board that it was in favour of the final block of units in the domestic tariff not being more than 1d (as from 1 May the rate has been raised by 0·1d to 1·1d. The new rate of the Eastern EB will be 1½d from 1 Oct.).

End of Newman Spinney

DEMOLITION of the Newman Spinney experimental underground gasification and power plant has reached an advanced stage. The main concrete walls of the power station were pulled down last week, leaving the 110 ft chimney as one of the few remaining structures left for testing and eventual destruction. The chimney will probably come down in July, it being planned to vibrate the structure until it collapses.

The Newman Spinney plant was originally built to extract gas from underground coal seams and use it to generate electricity. The experimental project, described in our 21 May, 1959, issue, was closed down nearly two years ago.

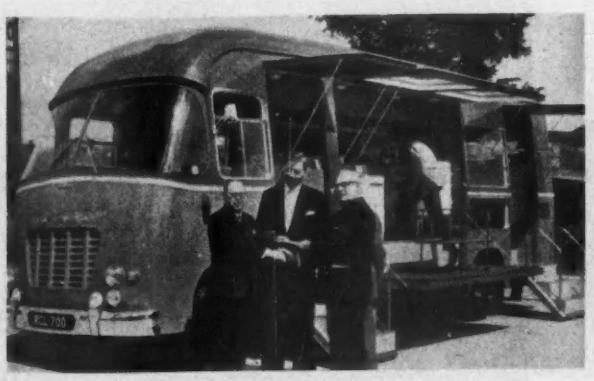
WERE E.T.U. SCRUTINEERS DECEIVED?

ALTHOUGH all allegations of misconduct in the ETU election were withdrawn against the two scrutineers, Mr J. W. F. Rengert and Mr C. Shipman, in the High Court action last week, the plaintiffs still maintain that the scrutineers acted wrongly in disqualifying certain branch votes and not disqualifying others. For the plaintiffs, Mr G. Gardiner, Q.C., maintained that the scrutineers were not deceivers but were themselves deceived. During his evidence, Mr Rengert admitted that he had relied on the statement that someone had checked through all the returns, and those in the "all clear" file were all right, but said that if he had noticed something wrong with any of them he would have said so.

Earlier, in cross examination, Mr R. Oliver, who worked full time for the ETU for 41 years until 1958 and then did part-time work for them, agreed that if Mr J. A. Humphrey, head office manager, had put any branch votes into the acceptance file when they ought not to have been accepted, they would have gone through.

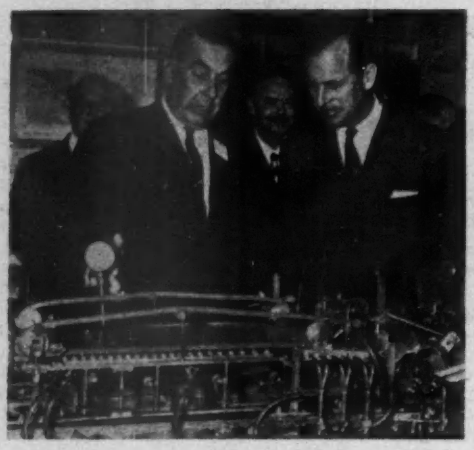
On Friday, after hearing that another 30 witnesses for the defendants were to be called, Mr Justice Wynn said he was attaching little importance to allegations about the Sept. 1957 election, but there were matters of great gravity on which a substantial *prima facie* case had been made out in the allegations of faking the Haxell election result.

Mr J. T. Byrne and Mr F. Chapple are seeking a declaration that Mr Haxell's election was void, and ask for damages for conspiracy against Mr Foulkes, Mr Haxell and 14 other ETU Executives. The hearing was adjourned till 30 May.



MOBILE SHOWROOM

This £4,000 mobile electricity showroom was put into commission this week by Eastern EB to bring "town" service to 520 villages in Norfolk Sub-Area. Designed by Mr R. F. Wolfe, the Sub-Area transport officer, it was formally handed over to Mr W. M. Bishop, the Norfolk Sub-Area manager, a few days ago. Besides display of cookers, washers, refrigerators, etc., the showroom will be used for demonstrations



HRH The Duke of Edinburgh gets a tip on making paper for cables from Dr A. L. Williams at the opening of the McFadzean laboratory of the BICC group last week. They are looking at a miniature paper-making machine, while Dr L. G. Brazier, BICC director, and director of research, looks on

Fire at Nuclear Factory

THE reactor building at Hawker Siddeley Nuclear Power Co.'s plant at Slough was extensively damaged by an explosion and fire late on Monday night. The explosion is believed to have occurred in the chemical section without involving radioactive materials. Personnel were not in the building and no one was hurt.

While the plant is being progressively shut down, following Hawker Siddeley's recent decision to cease nuclear research, a Jason 10 kW training reactor was operating there at the time of the outbreak. The Organic Moderated Reactor for Marine propulsion was also being developed at this factory, but the company is not going ahead with this.

Commercial Thermoelectric Refrigerators

A NEW hotel in Chicago is reported from the USA to be the first there to use thermoelectric refrigerator units produced on a commercial basis. Manufactured by the Norge Division of the Borg-Warner Corporation, 500 of them are being installed. Operating on the principle of the thermocouple in reverse, thermoelectric refrigerators have no compressors or other moving parts. The company concerned has estimated that their thermoelectric refrigerators will not be available for domestic use for more than three to five years. Two other American companies, General Electric and Westinghouse Electric, have demonstrated experimental models of thermoelectric refrigerators, but have not yet started commercial production. In the UK thermoelectric refrigerators that will lead to domestic models have been demonstrated by GEC.

Phoenix Reorganisation

THE Stockton-on-Tees factory of the Phoenix Telephone and Electric Works Ltd. will be closed this summer. This follows the takeover last July by Combined Telephone Holdings Ltd. and the consequent reorganisation of production. The manufacture of cables and cord, which has been carried out at Stockton since 1947, is to be transferred to the company's works at Hendon.

Mexican Trade Mission Arriving Soon

THE director-general of Mexico's Federal Electricity Commission will arrive in Britain within a few days as part of a trade mission which will be led by Señor Salinas, Minister for Commerce and Industry. The programme has not yet been finalised, as the visitors will not arrive all at once, but factory visits will be arranged to show the ability of British industry to supply equipment for Mexico's industrial development. No doubt the Mexicans already know what the US has to offer.

A market worth watching—

Demand for Appliances Growing in Jamaica

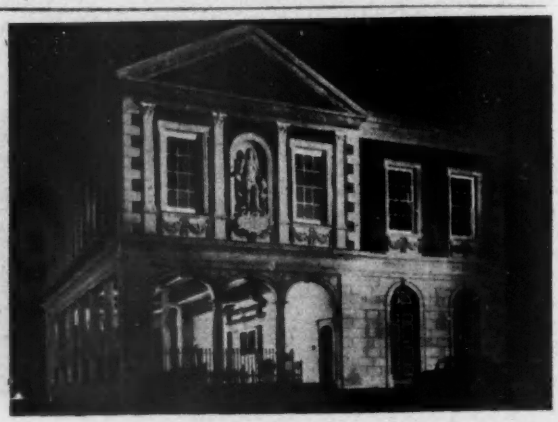
STEADILY rising living standards inevitably mean increasing sales of domestic appliances in Jamaica, and there is no local production. At the moment the market is small with only 53,000 electricity consumers out of a population of 1·7 million, but it is significant that one in ten of these consumers bought a refrigerator last year and there will be at least 10,000 new consumers by the end of 1963. US competition is the difficulty as far as UK makers are concerned. Until a couple of years ago British models were dominant, but the position was reversed in 1959, after dollar controls were eliminated, when the US doubled their turnover at UK's expense. Now the Americans are selling five times as many refrigerators as their British counterparts, and the Trade Commissioner at Kingston warns that unless UK manufacturers make larger models, and at a more competitive price, they are unlikely to retain even their present share of the market. Sometimes, as in other markets, UK models sell on the strength of a door lock with keys.

The sub-tropical climate and the availability of servants combine to make refrigerators the most sought after appliance, with fans a close second, but sales of washing machines are also growing. Even of the electricity consumers, not 5% have washing machines, but servants are gradually becoming scarcer as industry provides alternative jobs, and many of the houses now being built for the rising "middle class" are not designed to employ staff. UK washers sell well, and one gathers from the Export Service Bulletin that UK Hoover enjoy a major share of the market.

Gas cookers, using bottled supplies, outnumber their electric counterparts by six to one, with the result that imports of electric cookers amount to only £30,000-odd a year, and the majority of these come from the US. A similar position applies with water heaters; the US supplies the majority of all types and, as far as electric models are concerned, their prices are often 50% below UK quotations. A full range of smaller appliances is in the shops, with no lack of promotional activity, and Sweden, Italy and Japan are testing the market. However, the UK has a tariff advantage, the preferential rate for appliances being 20% against 30% for foreign competitors.

What is more, Jamaica is standardising on 50 c/s, instead of the 40 c/s which is most widespread on the island at present and the 60 c/s used in the US. A conversion programme is at present under way and for this reason, while there are virtually no import controls, licences are required to import frequency-sensitive equipment for the time being. Voltage in Jamaica is 110/220 V.

New Look at Windsor



Windsor's Guildhall under the floodlighting as part of the Civic Trusts' scheme, to which we referred last week. Installation was planned by Philips Lighting Design Service

BELVEDERE - WIMBLEDON UNDERGROUND CABLE

A £1¾ million contract for 132 kV underground cables between the CEGB Terminal Tower at Lessness, Belvedere, and their substation at Wimbledon, has been placed with British Insulated Callender's Cables Ltd. The cable route length is about 19 miles, and installation is to be completed in September, 1962.

There will be two circuits, each of three single-core oil-filled cables with 0·75 sq in. copper conductors to transmit a simultaneous load of 300 MVA, or 170 MVA with only one circuit loaded. One of the circuits will have a corrugated seamless aluminium sheath and the other, reinforced lead. Control and communication cables will be installed adjacent to the power cables.

The cable will provide a link with two other major 132 kV oil-filled cable installations which BICC already have in hand for the CEGB between Kingston and Wimbledon, and Kingston and Chessington.

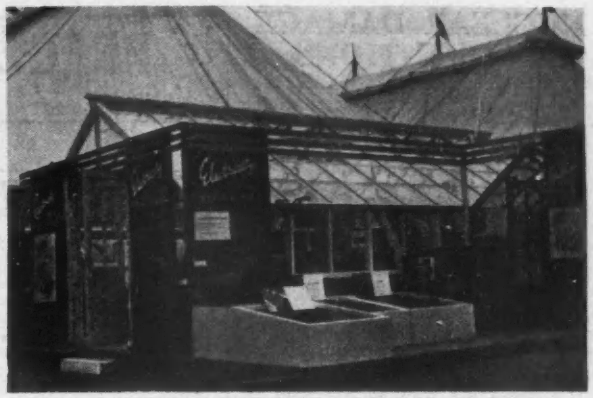
Aluminium Mill to Treble Capacity

BRITISH Aluminium, jointly owned by Reynolds Metals of the US and Tube Investments, are to treble capacity at their main aluminium rolling mills at Falkirk, Scotland. Present capacity is 50,000 tons a year. As part of the £10 million expansion programme they will build a hot mill about 172 in. wide, which will be the widest in the world.

NEW SHOWROOMS FOR THERMODARE

PERMANENT displays of floor heating, infra-red and thermal storage heaters are a feature of the new Thermodare (Great Britain) showrooms in Petty France which opened last week. Since the company introduced thermal storage heaters to this country ten years ago they have moved offices three times. Now with a fourth move they have opened a showroom where technical assistants are available to discuss problems with architects and contractors.

The move was made necessary by further expansion into the domestic field with both infra-red and thermal storage heaters and also because in previous buildings there was no adequate space to exhibit products.



Horticultural uses of electricity were shown by EDA at the Chelsea Flower Show last week. The two main features were a commercial greenhouse showing how a Hampshire nursery has increased output and cut costs by using electricity in compost mixing, propagating and for water supplies and heating; the second was a small greenhouse for the amateur. As in previous years the emphasis was on automatic control and labour saving. The exterior is pictured here

TESTING BOILER FLUE GASES

TECHNIQUES for rapid assessment of boiler flue gases from the aspect of fouling and corrosion troubles are described in Bulletin No. 11 of the Boiler Availability Committee, published recently. Several methods based on insertion of probes into the gas stream are described in sufficient detail to permit their use without reference to other sources.

Most of the methods described are intended for tests of short duration, yielding results within the hour, and are thus better suited for comparison of different methods of boiler operation or of variations in fuel characteristics, rather than precise prediction of how long trouble-free service is likely to be obtained. However, some of the tests are suitable for use over longer periods, and give results that may be extrapolated to give the likely life.

The committee comments that current research is likely to lead to new and improved techniques. In particular, considerable effort is being expended to substitute automatic recording instruments for hand-operated apparatus.

Copies of the bulletin are obtainable by industrial organisations from British manufacturers of water tube boilers by application to the nearest representative or agent, either at home or overseas.

ELECTROLUX BAN PRICE CUTTING

ANOTHER blow for retail price maintenance has been struck by Electrolux Ltd. They have obtained an undertaking that their products will not be sold below fixed prices from Grandways, the Leeds discount store. Terms of the undertaking are similar to those of a recent court injunction against the operators of Grandways, Associated and Independent Merchandisers Ltd., restraining them from cutting prices on Frigidaire goods.

Display for Country Folk at Devon Show

THE whole of South Western EB's extensive stand at the Devon County Show at Exeter last week was devoted to "Electricity on the Farm"—not only up-to-date methods in grain and hay drying and plant propagation, but also the quiet revolution taking place in centuries old farmhouse kitchens. On the farming side, equipment was illustrated which can cheaply convert an old barn into a modern crop-drying plant, and electrical methods of milling home produced feeding stuffs to provide cheaper concentrate rations also aroused considerable interest.

But most of the men were steered first by their womenfolk to the domestic section, there to be shown a kitchen with the most modern automatic electric cooker, dishwasher and other labour-saving devices, and a dining-room revolutionised with varying forms of heating and a Diner-cold refrigerator.

FLOOR-WARMING CONFERENCE

THERE is already some 50,000,000 sq ft of electrically warmed floorspace in this country, 150 architects who attended a conference on electric floor-warming, at Shirley Pk Hotel, were told. Organised by the South Eastern Electricity Board, the conference included papers on "Off-peak Floor-warming as a Central Heating Service," by Mr R. C. Gordon, commercial engineer, and on "Running Costs and Maintenance," by Mr M. W. Hime, assistant chief commericial officer, and was followed by a lively discussion period and an address by the chairman.

A view of the showroom with displays of infra-red heaters, the night storage heater and floor-warming

NUCLEAR DAMAGE CONVENTIONS

AN intergovernmental committee convened by the International Atomic Energy Agency has produced a draft convention on "minimum international standards regarding civil liability for nuclear hazards." The convention deals with hazards arising from land-based nuclear installations, and those associated with transport of nuclear material. It provides a framework of uniform basic principles for dealing on an international scale with the legal problems involved. The draft is to be submitted to the Board of Governors of IAEA, and it is possible that an international diplomatic conference may be convened to conclude an international convention based on it.

Design Congress Aimed at Bulk Buyers

THE Council of Industrial Design have begun making arrangements for an international design congress which they will stage at the Royal Society of Arts in the autumn. Since the war these congresses have been held every five years, with varying themes. This year the programme will be directed at bulk purchasers and contract buyers.

International Copper Development

MEMBERS of the Copper Development Directors' Committee recently assembled in England at Folkestone for their eleventh meeting. Representatives from Belgium, Canada, Denmark, France, Germany, Italy and Switzerland attended on this occasion. The agenda of each day's conference included a variety of technical and administrative matters of mutual concern to each of the centres in their furtherance of the efficient development and use of copper and its alloys. The arrangements were organised by the Copper Development Association of Great Britain, and on the final day the party of overseas visitors were entertained to luncheon by the Anglo-American Corporation of South Africa Ltd. at their London headquarters.

During the course of the meeting, the formation of a Copper Development Centre in Australia was announced.

Sayings OF THE WEEK

"Presumably this (an 'outage') is the Generating Board's jargon for a power failure. May one assume, therefore, that the restoration of the current is an 'inage'?" . . . G. F. MALES, writing to the *Daily Telegraph* on the power failure.

"One of the curious things about broadcasting is that people often hear things which have not been said." . . . MR CARLTON GREENE, director-general, BBC.

PRICES of cable metals and other materials

Figures quoted are the official prices ruling on Tuesday, May 23

	£ per ton	Weekly change £		£ per ton	Weekly change £
COPPER, standard class A (settlement)	248½	+3½	ZINC, virgin, min. 98% purity (cash)	82½	+1½
" (3 months)	240½	+3	" (3 months)	82½	+1½
LEAD, refined pig, 99·97% purity (cash)	66½	−⅛	RUBBER, per lb. No. 1, RSS, spot	26½d	−⅛d
" (3 months)	67½	−⅛	c.i.f. basis, ports, July	25½d	−1d
TIN, refined, min. 99·75% purity (settlement)	870	+½	ARMOURING: Galv. Steel Wire (0·104 in.)	67½	—
(3 months)	873½	—	Mild Steel Tape (0·04 in.)	53*	—
ALUMINIUM, ingots 99·99·5%	186	—	NICKEL (home)	600	—
wire bars (4×4×54")	193½	—	MERCURY (76 lb flask)	67	—
BRASS Strip 63/37	211½	—	AMERICAN PRICES: Copper, electrolytic (per lb)	31c	+1
SILVER (Troy oz)	79½d	+½d	Lead, (New York)	11c	—

* *Tape Price, now an average, includes varnishing*

MARKETING ELECTRONIC GLASSWARE

HIGH stability metal-oxide-on-glass electronic components, manufactured in this country by James A. Jobling and in America by Corning Glass are to be marketed by a new company, Electrosil Ltd., Colnbrook By-pass, Slough. The characteristics of the metal oxide film used for resistors include a temperature coefficient guaranteed at ±0·03% and exceptionally good shelf life stability. The resistors range from ¼ W to 115 W rating and from 10 kilohm to 4·22 megohm. Now becoming available is a new material, "Fotoceram," which is a light sensitive glass for printed circuit use. Suitable for working temperatures up to 250°C and with good dimensional stability, "Fotoceram" can be used for prototype work in conjunction with chemical machining.

IMMERSION HEATERS WANTED

OVER 700 tenants of council areas in Dartford rural area have applied to the Council for immersion heaters to be installed. This was reported by Mr B. F. Kirby, engineer and surveyor, at a meeting of Dartford (Kent) Rural Council earlier this month. The Council agreed to ask the South Eastern Electricity Board to submit an estimate for the work, and empowered Mr Kirby and the chairman of the Housing Committee to accept the estimate if it is reasonable.

A.S.E.E. Chairman Slates Payroll Tax

THE latent payroll tax introduced in the last Budget was criticised by the ASEE chairman, Mr G. G. Kitchener, when he opened the Association's annual conference at Brighton last week-end. He took the view that by minimising the number of employees, the tax, if imposed, would increase overtime working and so lead to a fall in productivity. Too much overtime was being worked already, and any more would be no encouragement to supervisory staff often receiving less money than the workers they supervised, he said.

Another point that Mr Kitchener emphasised was that the supervisor should get his employer to put down on paper the basic conditions of his service.

Flood Work Wins Prize for Bath

THE rescue of £600 worth of appliances from Old Bridge service centre one night last December, when flood waters were cascading in from three sides, earned for Bath district of SWEB this year's award of the Western Daily Press trophy for the most outstanding achievement by the Board's staff. After an explosion and fire had blacked out much of Bath, many of the staff worked around the clock to restore supplies.

News in Brief

Eastern Electricity Board opened new showrooms and offices at 14 North St, Sudbury, Suffolk, last week.

Edinburgh Town Council have agreed to pay half the estimated cost of £620 for decorative lighting in Princes St for the Festival and the Christmas period.

The sixteenth annual Electronics, Instruments and Components Exhibition and conference of the Institution of Electronics will be held at the College of Science and Technology, Manchester, on 6 July to 12 July.

Having installed a scrap-recovery plant, Johnson, Matthey and Co. Ltd. are now seeking to purchase quantities of germanium scrap.

For the next Mechanical Handling Exhibition at Earls Court, from 8 May to 18 May, 1962, the organisers have added another 25,000 sq ft to the normal exhibition area.

Six more miles of Kent railway line, between Westenhanger and Folkestone, were electrified on 24 May.

Owing to the construction of a new through road at Durham City, which will interfere with their present premises, the North Eastern Electricity Board are considering the erection of new area headquarters at Durham.

OVERSEAS NEWS

from our correspondents abroad

CANADA

Largest Thermal Plant

The Richard L. Hearn generating station of the Hydro-Electric Power Commission of Ontario is now Canada's largest thermal power plant, following the installation of the final generating set recently. Installed capacity is now 1,200 MW. The first half of the station, completed in 1953, had four 100 MW sets. The extension, started in 1956, consists of four 200 MW sets.

Record Peak

A new peak load of 5,745·7 MW was carried by the Hydro-Electric Power Commission of Ontario last December—nearly 190 MW higher than a year earlier, preliminary details of operations for 1960 show. Total units sold in the year increased by 3·4%. Aggregate generating capacity at the end of December was 6,526·2 MW.

New H.E. Scheme

A new hydro-electric power plant at Gold River, near Chester Basin, is being planned by Nova Scotia Light and Power Co. An application has been made under the provincial Water Act for permission to use river and tributaries, which if granted would involve the construction of dams, canals, pipelines, spillways and power houses.

U.S.S.R.

Grid Scheme

An integrated scheme covering all the power grids that are already in operation or which are to be built in the USSR is nearing completion. These grids will cover the whole country. The scheme is expected to be ready within the next three months. By 1970 the most densely populated districts of the USSR—about 3,280,000 square miles—will receive power from the national grids, while outlying districts will be supplied from local power stations whose erection is also provided for in the development plans. It is anticipated that in the next few years the consumption of electricity will grow at a particularly rapid rate in agriculture, the electrification of which will be completed within the next five years. During this period, over 800,000 miles of transmission lines ranging from 400 kV to 110 kV will be built for agricultural needs. Experts in Leningrad have also prepared a preliminary plan for an o.h. d.c. transmission line 1,550 miles long, which will take to the Urals electricity generated by the Bratsk and Krasnoyarsk hydro-electric stations now being erected in Siberia.

ALGERIA

Fertiliser Plant

W. R. Grace and Co. have recently recommended the establishment of a nitrogenous fertiliser plant in a study commissioned by the Société Tunisienne de Banque, of Tunis, which indicated an interest in the establishment of such a plant in Tunisia and asked for a report on its feasibility. Grace and Co. recommended setting up a plant with an annual output of 14,100 metric tons of anhydrous ammonia and 79,000 metric tons of ammonium nitrate. The project would also require the installation of a 19,000 kW steam turbine electric generating plant. Cost of the entire project is estimated at $23,300,000.

INDIA

Delhi's Trouble

After Calcutta, Delhi is now facing a power supply shortage. This seems inevitable with the inability of the Punjab State Electricity Board to meet in full the additional 8,000 kW requested by the Delhi Electricity Supply Undertaking. That request was made following a decision to shut down for repairs a 9,600 kW plant at the Central power house in Delhi, in which a major defect was discovered. Punjab State Board have offered to provide 3,000 kW.

AUSTRALIA

More Amalgamation

Plans for further amalgamation of electricity distribution authorities in New South Wales are again under consideration by the Electricity Authority. The latter consider that the number should be reduced from the present 44, of which 36 are county councils, to less than 20. Mr F. H. Campbell, chairman of the Authority, has said that investigations are now being made of the technical and economic efficiency of the county councils, with a view to submitting recommendations to the State Government. The process of amalgamation has been in hand since 1946, when there were 188 separate electricity undertakings in the state.

Tariff Rise

An increase of 10% on all tariffs except the off-peak, to operate from 1 July, have been announced by the Hydro-Electric Commission of Tasmania. The off-peak rate is raised by 7·7%. But the Commission has introduced two concessions—a domestic rate of 1·6d for all consumption over 1,200 units/quarter, and a standard minimum charge for certain farm properties.

Electrical Retail Group

Ten stores recently became members of the latest South Australia-owned electrical retail group. Backed by Cornell (Holdings) Ltd., the move follows the pattern set in the eastern states, found necessary to maintain quality without price increase. A feature will be an efficient after-sales service maintained by a fleet of 20 radio-controlled vehicles. The stores involved in the merger are in the south western and northern suburbs of Adelaide and at Whyalla, Port Augusta and Port Pirie.

NEW ZEALAND

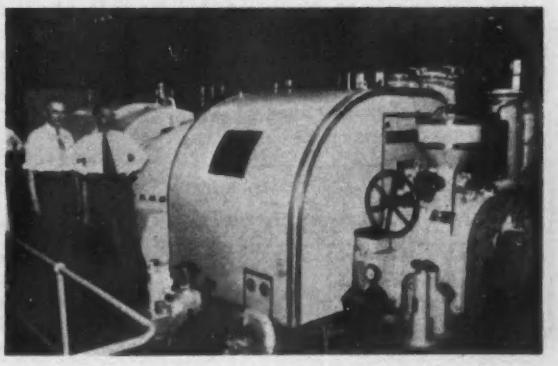
Circuit-breakers Ordered

Eight 220 kV, 5,000 MVA air-blast circuit-breakers for installation at Aratiatia and Atiamuri have been ordered from Associated Electrical Industries Ltd. by the New Zealand Electricity Department. The company are already supplying a similar number of 220 kV, 7,500 MVA air-blast breakers for Maraetai I and II power stations.

S. VIETNAM

H.E. Scheme

Work has now started on the Da-Nhim hydro-electric scheme, in South Vietnam, which is being carried out by Japan as part of war reparations. A dam is to be built across the River Da-Nhim to utilise a drop in the water level of about 800 metres. The power station is to have four 40 MW Pelton wheel turbines, whose output will be transmitted by 250 km of 230 kV line to Thu Duc, just north of Saigon.



At the inauguration of a new English Electric 10 MW turbo alternator set at the Burri power station, Sudan, Mr F. S. Batty, general manager, Central Electricity and Water Administration, with Mr A. V. Mathias, of EE General Engineering Projects Dept. That company also erected the associated 33 kV transmission line to Kilotan substation. Capacity of Burri power station is now 40 MW (30 MW steam and 10 MW diesel). It can meet most of the power demands of Khartoum and surrounding districts.

Company Activities

IN the week of the big blackout, when at least one City correspondent was constrained to continue his eventide commentaries with the aid of an Ever Ready car lamp placed suitably above his typewriter, there remained still on stock markets a large measure of light surrounding most industrial issues. And when prices were showing in the first part of the week a tendency to flag, along came the April trade figures to re-energise the market. With a "trade gap" of only £24 million in April, this was the lowest since May, 1959, and compares with a gap of £73·7 million in March. April exports in fact were up from £309·9 million in the previous month to £318·6 million, although re-exports were down from £15·3 million to £12·7 million. On the other side of the account, imports in April were down from £398·9 million in March to £355·3 million. Yet at the same time these figures need to be treated with a certain amount of reserve since most of the improvement can be seen to derive from the fall on imports, and towards this the recent London dock strike which started towards the end of April will have contributed. Progress on exports, on the other hand, still leaves plenty of room for improvement.

For electrical shares the week was one of irregularity. Thus, the big three all showed a tendency to harden—AEI moved up from 42s 6d to 43 3d, GEC were 3d dearer at 38s 6d and English Electric improved from 35s to 35s 3d. Then Ether Langham Thompson, makers of temperature and process control equipment, warmed up from 23s 7½d to 26s 1½d on persistent demand for the shares and it would not surprise in the least if old takeover rumours are now revived. By contrast, Dimplex of heater fame saw their 5s Ordinary shares cool from 76s 3d to 73s 3d on a steady stream of profit taking. On favourable comment and record production news the shares have risen from a low point this year of 47s 9d.

Having sold their radio and TV offshoots to Thorn, Ultra Electronics shares were marked back from 31s 3d to 27s but still buyers, especially the Americans, came in for the shares so that they were able to finish the week near 32s. Thorn, too, dipped from 59s to 58s and then slid further to 57s 9d.

Plessey was also in the electrical news again last week with its interim dividend which has been raised from 7% to 8½%, and upon this the shares, which were inclined to ease, picked up from 59s 6d to 59s 9d. Not so, however, with Aerialite, the electric cable and television aerial makers. Chairman Mr L. Hargreaves' cut in the interim from 20% to 15% and his statement that "it is prudent that dividends should be watched more carefully than in the past in view of the extreme competition in the cable industry and the reduction in the television business . . ." served to knock down the company's 1s Ordinary shares from 7s 9d to 6s 3d. He also warned that current profits are reduced.—*From our City Correspondent.*

Bowthorpe Holdings

Dividend is raised by an effective 3½% to 22% with pre-tax profit up slightly from £687,555 to £704,365. But higher tax leaves a net profit of £369,003 against £375,923 previously.

T. Clarke and Co.

Partly through takeovers, the company's business is expanding rapidly and the chairman's report with the accounts is full of confidence. The volume of work being carried out this month is such that the operating staff is about 30% higher than in May last year, though the acquisition in January of Veale-Nixon Ltd., one of the leading electrical contractors in the north, is a factor in this increase. Operating staff received a 20% wage rise at the beginning of this year, and the chairman says that it is for this reason that the dividend was maintained at 16% to conserve funds despite higher profit, "but I am confident that satisfactory progress will be made in the future," he adds in this context. It would appear that something more than an equivalent rate is likely following the forthcoming one-for-two scrip issue.

Year to 31 Dec.	£ Trading Profit	£ Net Profit	% on Ord.		Ord. Price	
			Earned	Paid	High	Low
1956	104,408	35,194	40·8	16	4/–	2/9
1957	108,308	35,008	40·6	16	3/10	3/1
1958	121,344	45,078	49·6	16	4/6	3/1
1959	112,208	43,570	32·3*	16*	5/9	3/2
1960	123,758	45,974	31·3	16	6/3	4/7

* After a one-for-three scrip issue

Ever Ready (GB)

Net profit is up from £1,550,982 to £1,706,526 for the year to 25 Feb. Dividend is raised by 2½% to 22½% and absorbs £708,480 net. Directors say reserves total £4,289,748 compared with £3,209,660 a year ago, and the book value of trade investments has increased from £773,017 to £1,505,787 with a market value of £2,666,668 (*£1,287,453*).

Mavor and Coulson

The shortage of orders has been reversed and overtime is being worked. The influx of orders in the first three months of this year was the greatest for three years, and if this rate is maintained directors are confident of a more satisfactory result than in 1959 or 1960.

Simms Motor and Electronics

Mr G. E. Liardet, chairman, is clearly expecting another good year. Order books and output at all factories are running at record levels, and if high volume output can be maintained "members will not be disappointed," he says in his report with the accounts. Dependence on the motor industry has been lessened by the diversification plan, which has worked out well, and particular attention is being given to electronics.

E. and H. P. Smith

Group profit is up from £26,339 to £53,320 for the year to March 31, which is well ahead of the £42,000 forecast by directors in January at the time Chaphone Engineering was acquired. In addition to three months' earnings from Chaphone, who make honing equipment, profits of Stevens Brothers (Wolverhampton), precision engineers, are included for the first time. Dividend is raised by 7½% to 22½% on higher capital and takes £11,025 (previously £7,350) of the £26,285 preliminary net profit (*£14,160*).

Transformers (Watford)

The company is finding transformer business sufficiently profitable to expand its activities into the manufacture of larger types, and new buildings are being erected for this purpose alongside the existing works. The move, which began with the acquisition of adjoining land in 1959, is justified by present conditions, for the volume of work required for the new assembly shop is "well covered by the order book, which stands at a most encouraging figure." Last year, higher output was reflected in increased trading profits, despite severe competition and a rise in labour costs. Close attention to design, involving some savings in the cost of materials, was an important factor in the better earnings. This was revealed at the annual meeting of the parent company, London Brick, last week. Sales of the Clay electric cable covers manufactured by the parent company continued to expand satisfactorily.

Worthington-Simpson

Orders for the standard range of hydraulic and engineering products have been coming in at a record rate and the order book is "very satisfactory." However, the chairman expresses some fears that margins may shrink. With record output last year, trading profits rose from £975,272 to £1,093,920 and dividend was lifted by 5% to 25%.

Dividends Declared

Aerialite. Interim is cut from 20% to 15%.

Plessey. Interim is raised by 1½% to 8½%.

S. Smith and Sons. Interim is raised from 4½% to 7½% but directors expect to pay a steady 20% for the year. Estimated profit is revised downward to around £3 million.

COMMERCIAL INFORMATION

Contracts Open at Home . . .

Dates given are the final for receipt of tenders unless otherwise stated.

25 May—Lewisham B.C. Street lighting conversion schemes: (1) 190 Group "A" to 140 W sodium; (2) 242 to 200 W linear sodium; (3) Group "B" to 60 W sodium; (4) erection of 81 Group "A" steel columns complete with linear 200 W sodium lanterns, etc.—See 18 May issue.

26 May—Cardiff C.C. Electrical installation, on fixed-price basis, in Technical High School.—See 11 May issue.

26 May—Londonderry C.C.—Electrical installation in Draperstown School meals kitchen/dining hall.—See 11 May issue.

26 May—Middlesbrough C.B.C. Supply: lamps.—See 18 May issue.

26 May—Plymouth C.C. Rewiring at public secondary boys' and girls' schools, Coburg St.—Advertised 11 May issue.

26 May—Worksop B.C. Provision of eight fluorescent lighting units, ten socket-outlets and necessary wiring in building at Carlton Rd Tip. Borough Engineer, Park Hse.

27 May—Bath C.C. Electrical installation in proposed extension to students' hostel accommodation, 5-7 Somerset Pl. Applications to architect: H. D. Roberts, 30 Brock St, by above date. N.I.C. firms only.

27 May—Blackburn C.B.C. (3) Supply: instruments/accessories for Technical College.—See 18 May issue.

27 May—Glenrothes D.C. Electrical installations in 40 houses in South Parks Fourth Development. Applications to Secretary, Glenrothes, Fife, by above date.

27 May—Ross and Cromarty C.C. (g) Electrical work in two three-apartment and two four-apartment houses at Hilton. Applications to quantity surveyors: R. Armour and Ptnrs., 375 Union St, Aberdeen, by above date.

27 May—Surrey C.C. Installation of 18 tubular steel columns and 22 400 W mercury lanterns at Glanty roundabout, Egham.—See 11 May issue.

29 May—Breconshire C.C. Electrical installation in four-stream secondary modern school, Brecon.—See 18 May issue.

29 May—Coulsdon and Purley U.D.C. Provision of 182 Stanton Group "A" concrete columns; provision and fixing of 60 W and 140 W sodium lamps and G.E.C. lanterns; plus removal of existing street lighting.—Advertised 11 May issue.

29 May—Hastings B.C. Electrical installations in (a) 22 dwellings, Gate Farm extension; and (b) 73 dwellings, Broomsgrove Redevelopment area. Borough Engineer, 37 Wellington Sq. Deposit £2 2s.

29 May—Larne B.C. Electrical installation in Municipal Offices.—See 18 May issue.

29 May—Liverpool C.C. Supply of domestic appliances. Central Purchasing Officer, New Oxford Hse, 75 Dale St.

29 May—Manchester C.C. Supply of two main generators 45 kW 220 V d.c. for sludge vessel *Mancunian* conversion.—See 4 May issue.

29 May—Manchester C.C. Electrical installation in Aged Persons' Home, Felskirk Rd, Wythenshawe.—See 4 May issue.

29 May—Sunderland C.B.C. Electrical installation in public abattoir meat market, Fulwell.—Advertised 11 May issue.

29 May—West Riding C.C. Rewiring and fire alarm installation, Children's Home, Bramham House.—See 4 May issue.

30 May—Ealing B.C. (a) Supply of 3,600 sodium lanterns/lamps/gear; (b) supply of 1,500 brackets and 500 control gear boxes.—Advertised 11 May issue.

30 May—Kirkham U.D.C. Supply, erection and installation of 14 Group "B" concrete columns and 80 W m.v. lighting/gear/wiring, Freckleton Rd.—See 27 April issue.

30 May—Manchester C.C. Contract 260c. Electrical installations in four shops and maisonnettes, St. George's redevelopment. Director of Housing, Town Hall.

30 May—Renfrew C.C. Electrical installation, including floor-warming, at Renfrew High School. Apply to R. Urquhart, County Clerk, County Buildings, Paisley, by above date.

31 May—Dunbarton C.C. Erection and wiring of fluorescent street and footpath points as follows: Seafar 2 area: 89 units; Seafar 4 area: 25 units; and Muirhead 1 area: 63 units, Cumbernauld New Town. County Lighting Superintendent: W. Arthur, 24 George Sq, Glasgow C.2. Applications by above date.

31 May—Durham C.C. Electrical installations in Police houses at Peterlee and Meadowfield. Apply to County Architect, South St, Durham, by above date.

1 June—St. Albans C.C. Supply of Group "A" concrete lighting columns for conversion scheme.—See 18 May issue.

1 June—Soke of Peterborough C.C. Provision of new supply cable to blocks, Elmside and Harrowdene, at St. John's Close, Thorpe Rd. County Surveyor, Bridge St. Deposit £2 2s.

2 June—E.B. for N. Ireland. Supply and erection of circulation water pipework and valves at Coolkeeragh.—See 4 May issue.

3 June—Carrickfergus B.C. Supply and erection of 83 4 ft 40 W fluorescent lanterns and 129 2 by 2 ft fluorescent lanterns.—See 18 May issue.

3 June—Saddleworth U.D.C. Supply and erection of 174 concrete columns/brackets/gear and wiring on various roads. Lighting Superintendent: G. H. Booth, Council Offices, Uppermill, nr. Oldham.

5 June—Aireborough U.D.C. (1) Supply/erection of 59 Class "B"' columns/brackets and fitting/wiring of lanterns; (2) supply of mercury vapour lanterns/gear.—Advertised 4 May issue.

5 June—Brighton C.B.C. Electrical installation on fixed price basis, Teachers' Training College, 9-10 Percival Terr.—See 18 May issue.

5 June—Hereford T.C. Provision of 187 Group "B" lighting units, comprising 29 sodium with new columns with the remaining as tungsten units, and include erection of new columns and conversion and resiting work.—Advertised 18 May issue.

5 June—Northern Ireland. Applications invited for inclusion in approved list of electrical contractors for M. of Commerce.—See 18 May issue.

7 June—Bingley U.D.C. Supply (except columns) and erection of 48 Class "B" lighting units. Surveyor, Town Hall.

7 June—Newtownabbey. Supply and installation of wired television system. Northern Ireland Multivision Ltd., 18 Arthur St, Belfast 1. Deposit £1 1s.

7 June—Wallasey C.B.C. Supply of 52 Group "B" concrete columns and post top lanterns.—See 18 May issue.

8 June—Heston and Isleworth B.C. Provision and erection of 23 double-arm and six single-arm columns with 400 W mercury fluorescent aero-screened lanterns/gear along A4 Bath Rd from Henley's Corner to Cranford Bridge. Borough Engineer's Dept., 88 Lampton Rd, Hounslow. Deposit £2 2s.—Advertised in this issue.

8 June—Wood Green B.C. (a) Provision/erection of 155 Group "A" concrete columns; (b) provision of 40 140 W sodium lanterns/gear; (c) provision of 115 3 x 80 W fluorescent lanterns/gear. Borough Engineer, Town Hall, N.22.

9 June—Hereford T.C. Wiring of 147 houses and 12 bungalows on Newton Farm Five estate.—Advertised 18 May issue.

9 June—Westport, Co. Mayo. (b) Electrical installation comprising 10 kV switch panel, 640 kVA transformer, 1,200 A l.t. switchboard, p.f. correction equipment and distribution system for 427 power points (800 h.p.), 795 lighting points including 628 twin-tube 80 W fluorescent fittings, emergency lighting, 60 socket-outlets, nine water heaters, telephone, clock and fire alarm systems. Details from consulting engineer: P. J. Tobin, 22 Eyre Sq, Galway. Deposit £26 5s.

10 June—Havant and Waterloo U.D.C. (14) Supply of cable and fittings. Engineer and Surveyor, 1 Park Rd North, Havant.

10 June—Heywood B.C. Supply of: (1) 60 W so/h lanterns; (2) transformers and capacitors; (3) controllers; (4) columns. Street Lighting Superintendent: W. Theaker, Market Hall, Hend Hill St.

12 June—Enniskillen B.C. Conversion of mercury to fluorescent street lighting. Borough Surveyor, Town Hall.

12 June—Romsey B.C. Installation of power points in 160 pre-war houses. Borough Surveyor, Town Hall.

Your Queries Answered

Readers are invited to make use of our free enquiry department which possesses wide resources, including an index of trade information with over 100,000 entries

A Selection from the 114 queries answered this week

Ceiling rose with 2 A socket-outlet—makers of? B.M.R.—Ranton and Co. Ltd., Commerce Way, Brentford, Middx.

Battery-operated drill—makers of? E.S.A.R.—These are to be handled by Black and Decker Ltd., Harmondsworth, Middx.

"Stenor" and "Romac" vulcanisers—makers of? B.D.Y.—(a) Stenor Ltd., 37 Key Fort Rd, Richmond, Surrey; (b) Romac Industries Ltd., The Hyde, Hendon, N.W.9.

"Vineta" Dutch washing machine—agents for? B. and S.—R. S. Stokvis and Sons Ltd., 12-16 High St, Walton-on-Thames.

"Bico" washing machines—agents for? E.S.—Superbia Ltd., 99 Charlotte St, W.1.

"Bestfriend" hair driers—repairers of? T.F.—T. A. Boxal and Co., 20 Balcombe Rd, Horley, Surrey.

"Sony" transistor radios—agents for? Tellux Ltd., 44 Brunel Rd, W.3.

"Stub-lok" miniature circuit-breakers—makers of? B.C.—E.C.C. (Moulded Breakers) Ltd., Fordhouse Rd, Wolverhampton.

"McClary-Easy" appliances—agents for? R.F.—General Steel Wares Ltd., Regina Hse, 259 Marylebone Rd, N.W.1.

12 June—Sedgley U.D.C. Provision of 125 Group "B" 80 W mercury fluorescent lighting units on 15 ft concrete columns (columns arranged). Engineer and Surveyor: W. M. Jones, The Limes, Dudley Rd. Deposit £2 2s.

13 June—Cheshunt U.D.C. Provision of metal extension brackets, plus erection and wiring of concrete columns/brackets/200 W sodium lamps/gear. Engineer and Surveyor, Manor Hse, Turners Hill. Deposit £2.

13 June—West Riding C.C. (4) Rewiring of Westerton J.M. and I. School.—See 18 May issue.

16 June—Lanark C.C. ((1) 42 140 W sodium lanterns/gear for A8 Salsburgh scheme; (2) (a) 50 140 W sodium lanterns; (b) 50 transformers; (c) capacitors for A8 Harthill scheme. Assistant Engineer (Lighting), 23 Beckford St, Hamilton.—Advertised in this issue.

17 June—Whitchurch U.D.C. Dismantling of existing lighting and supply/erection/fitting of 70 30 ft steel columns and 200 W sodium lighting on A.41 and A.49. Engineer and Surveyor, Paul's Moss, Dodington, Whitchurch. Deposit £2 2s.—Advertised in this issue.

19 June—Stocksbridge U.D.C. Supply/erection/putting into service of 255 60 W sodium lighting on 15 ft concrete columns. Surveyor, D. E. Robinson, Town Hall.

29 June—Wortley R.D.C. (3) Supply and installation of 32 cookers on fixed-price basis. Engineer and Surveyor, A. Wikeley, Council Offices, Grenoside, Sheffield.

No date stated—Ayr C.C. Supply of: (1) concrete columns; (2) electrical equipment; (3) 140 W so./h. lanterns; and (4) erection, for Kilwinning By-pass roundabout lighting. —See 18 May issue.

No date stated—Clun R.D.C. Electrical installations in four houses, Amblecote, and two at Chapel Lawn. Surveyor: H. Bramwell, The Square, Bishop's Castle.

No date stated—Somerset C.C. Supply of heavy duty cooking equipment, water heaters, potato peelers, mixing machines, etc. Chief Education Officer, Trull Rd, Taunton.

14 June—America. Three 36,300 kVA 13·2/161 kV transformers for units 7 and 8 Bull Shoals Dam and Reservoir. U.S. Corps of Engrs, Little Rock District. B.o.T. (ESB/15818/61).*

14 June—New Zealand. Fifteen 4 kW and 59 eight to 100 kW engine/alternator sets. Director-General (Stores Division), G.P.O., Wellington. B.o.T. (ESB/15891/61).*

15 June—America. Three 26/34·667/43·333 MVA 230/132·8 kV transformers. Dept. of the Interior, Bureau of Reclamation, Bldg 53, Denver Federal Center, Denver 25. B.o.T. (ESB/15820/61).*

16 June—India. (a) 11 mile of double-circuit 66 kV line and (b) 84 mile of single-circuit 66 kV line complete with towers for Jaldhaka H.E. Project. Chief Engineer, W. Bengal S.E.B., 14 Princep St, Calcutta 13. B.o.T. (ESB/15822/61).*

20 June—Iceland. Power station equipment for River Sog/Ellidar H.E. extensions (28 items). Sogsvirkjun. B.o.T. (ESB/15843/61).*

1 July—Iran. Alternative fuel engine/generators for up to 20 MW extension. Shiraz Electricity Plant, Shiraz. B.o.T. (ESB/15260/61).*

6 July—Thailand. One 50/60 MVA 13·8 kV synchronous condenser and three 15/20 MVA 69/13.2 kV transformers for Yanhee Project. Director-General, Royal Irrigation Dept., Bangkok. B.o.T. (ESB/15816/61).*

10 July—Ghana. 4,600 fluorescent fittings complete with tubes. Secretary, Ghana Supply Commission, P.O. Box M35, Accra. —Advertised in this issue.

31 July—Trinidad and Tobago. 20 miles 33 kV gas filled submarine cable. Purchasing Officer, Electricity Commission, P.O. Box 121, Port of Spain.—Advertised in this issue.

5 Sept.—Ghana. (Contract A4.) Turbines and governors; (A5) generators, transformers and major electrical equipment; (A6) cranes and hoists; (A7) penstocks; (A8) gates, trashracks and rolling hatch covers; (L1) 161 kV transmission lines; (S1) 161 kV substation equipment; (S2) warehouses and personnel housing for Akosombo (Volta) scheme. Kaiser Engrs. and Constructors Inc., 300 Lakeside Drive, Oakland 12, California, U.S.A. Documents fee: £G17 17s 6d each contract.

CONTRACTS PLACED

C.E.G.B. Contracts placed during the past month, amounting to £1,800,000, include: Thorpe Marsh power station: low pressure pipework and valves, Matthew Hall and Co. Ltd.; one 550 MW reheat boiler (No. 2), Babcock and Wilcox Ltd.—Drakelow "C" power station: contactor control gear, Nos. 9 and 10 units, Associated Electrical Industries Ltd.—Drakelow "A," "B" and "C" power stations: permanent ash lagoon, Murphy Bros. Ltd.—Battersea power station: water treatment plant, Permutit Co. Ltd.—Bankside power station: installation of power and control cables for Nos. 3 and 4 sets and No. 5 boiler, Malcolm and Allan (London) Ltd.—Tilbury "B" power station: structural steelwork, roofing and cladding, Alex Findley and Co. Ltd.—Richborough power station: high pressure pipework and valves for No. 3 unit, John Thompson (Pipework) Ltd.—Addington substation: two 60 MVA 132/33 kV transformers, Yorkshire Electric Transformer Co. Ltd.—Slough (Chalvey) substation: two 45 MVA transformers, Bonar, Long and Co. Ltd.—Gloucester substation: two 180 MVA 275/132 kV transformers, Bruce Peebles and Co. Ltd.—Corby substation: site and foundation works, Turriff Construction Corp. Ltd.—Kirkby substation: two 180 MVA 275/132 kV transformers, Associated Electrical Industries Ltd.—Penwortham substation: 275 kV 15,000 MVA switchgear, Associated Electrical Industries Ltd.—Belvedere-Wimbledon: 132 kV cables, British Insulated Callender's Cables Ltd.

. . . and Overseas

*Details of items marked * may be obtained on application to the Board of Trade, Lacon Hse, Theobalds Rd, W.C.1, quoting reference.*

31 May—India. Pin and shackle insulators. Controller of Stores, Maharashtra S.E.B., Mercantile Bank Bldgs, Fort, Bombay 1. B.o.T. (ESB/15823/61).*

1 June—America. 230 kV transmission line towers. Dept. of the Interior, Bureau of Reclamation, Bldg 53, Denver Federal Center, Denver 25. B.o.T. (ESB/15500/61).*

6 June—America. One 12 MVA 115/7·2 kV transformer. U.S. Dept. of the Interior, Bonneville Power Admin., P.O. Box 3537, Portland 8, Oregon. B.o.T. (ESB/15882/61).*

Gazette Announcements

COMPANIES ACTS

Washer Services and Supplies Co. Ltd. Mr. G. H. Eaves, 47 Mosley St, Manchester 2, appointed liquidator at extraordinary general meeting on 4 May for the purpose of voluntarily winding-up.

Phillips and Dart (Electrical) Ltd. Mr R. A. Hawken, Bank Chmbrs, 1 John St, Bedford Row, W.C.1, appointed liquidator at extraordinary general meeting on 2 May for the purpose of voluntarily winding-up.

Walter (Sales) Ltd. Mr H. W. Pitt, 100 Park St, W.1, appointed liquidator at extraordinary general meeting on 1 May for the purpose of voluntarily winding-up.

Amplec Ltd. Mr A. Watson, 12 Hargreaves St, Burnley, appointed liquidator at extraordinary general meeting on 5 May for the purpose of voluntarily winding-up. Creditors to send details to liquidator by 31 May.

Electro-Horticultural Services Ltd. Mr J. S. Meyler, 2 Marlborough Pl, Brighton 1, appointed liquidator at extraordinary general meeting on 3 May for the purpose of voluntarily winding-up.

BANKRUPTCY ACTS

Receiving Orders

Birkenhead. E. J. Jones, electrical engineer, formerly carrying on business at 3 Tetbury St. Receiving order dated 10 May.

Brentford. H. McConkey, electrical equipment distributor, of 163 Davendish Ave, W.13. Receiving order dated 5 May.

Coventry. R. J. Eales, electrical contractor, carrying on business at 87 Lyndale Rd, Coventry. Receiving order dated 9 May.

Bristol. J. W. Hares, electrical contractor, carrying on business at 20 Bath Rd, Warmley. Receiving order dated 11 May.

Kingston upon Hull. F. Sutton, retailer of electrical goods and furniture, formerly carrying on business as Swift Electrics at 8 Southcoates La. Receiving order dated 11 May.

Peterborough. D. Hibbins, electrical and mechanical engineer, formerly carrying on business as Auto Electrical Repairs at 30 Newtown Rd, Ramsey. Receiving order dated 12 May.

First Meeting and Public Examination

Birkenhead. T. A. Craig, electrical dealer, formerly carrying on business from 1 Grange Mount, Birkenhead, and 13 North Drive, Wallasey. First meeting: 11 a.m. 25 May at Office of Official Receiver, West Africa Hse, 25 Water St, Liverpool 2, and public examination: 10.30 a.m. 3 July, Court Hse, Pilgrim St, Birkenhead.

TRADE NOTES

Changes of address. The offices of the Lead Development Association are now at 34 Berkeley Sq, W.1. Telephone: Grosvenor 8422.

The Middlesbrough branch of Honeywell Controls Ltd. has moved to 59-60 Albert Rd. The telephone number is unchanged.

Acquisition. Hilger and Watts Ltd. have acquired the capital of Wray (Optical Works) Ltd.

Licence agreement. Davidson and Co. Ltd. have completed an agreement with Apparatebau Rothemühle, of Germany, for the manufacture and sale of the latter's regenerative air preheater in the U.K. and various overseas territories.

Transistor service. S.C.I. Designs Ltd., 30-34 Ingate Pl, Queenstown Rd, S.W.8, has been formed to produce prototype transistor invertors to requirements.

Birmingham depot. The Electro-Chemical Engineering Co. Ltd. have opened a sales office and storage depot at Moor La, Witton, Birmingham.

Manufacturing agreement. A reciprocal sales and manufacturing arrangement has been established between the Wayne Kerr Laboratories Ltd. and Gertsch Products Inc., of Los Angeles, U.S.A. The agreement provides for the marketing and manufacturing of a wide range of Gertsch electronic instruments in the U.K. solely by Wayne Kerr and for the sale of Wayne Kerr instruments by Gertsch Products in California, Nevada and Arizona.

Australian clock inquiry. Application has been made to the Australian Ministry of Trade to increase the duty on electrically operated clock movements, other than master or secondary clocks, in order to assist local production. Concerns intending to submit evidence on the matter should notify the Australian authorities by 5 June.

BUSINESS PROSPECTS

Alcester. £150,000 R.C. secondary school to serve Evesham and district proposed.

Barking. Wm. Warne and Co. Ltd. propose rebuilding of factory. Architects: Higgins and Thomerson, Romford Rd, E.16.

Basildon. Fuller, Hall and Foulsham, High Holborn, W.C.1, architects for proposed 50,000 sq ft Spong Ltd. factory. D.C. propose nursery factories, No. 2 industrial area. Contractors: Hosking and Son (Essex) Ltd., Arterial Rd, Rayleigh.

Bath C.C. Tender: second instalment, infants' school, Twerton estate. Architect.

Berwick. Northumberland C.C. plan primary school, Falstone. County architect, Gt. North Rd, Newcastle.

Birmingham C.C. Tender: 27 four-storey dwellings, Northfield. City Architect.

Bishop's Stortford. Planned: transfer of St. Michael's C.E. School to new site. County Architect.

Bolton. Young and Son Ltd., Kay St, propose industrial development.

Bournemouth. Leek and Morland Building Society, New Stockwell Hse, Leek, propose shops/offices, Old Christchurch Rd. Casbah Ltd. propose four-storey offices, Hinton Bldgs, Hinton Rd.

Bristol. Rodwell Group, Hertford St, W.1, propose £400,000 eight-storey offices, Marsh St.

Burnley. Third phase of extensions to new factory, Heansford site, Western Ave, proposed by Belling and Co., Bridge Wks, Enfield. Massey's Burnley Brewery Ltd., Bridge End, propose redevelopment of Parker La, Boot St, site. Burnley Building Society, Grimshaw St, propose extensions to head offices.

Canterbury. H.M. Prison Commissioners propose hospital block, Canterbury Gaol.

Cheltenham. Planned: extensions to The College, St. George's Pl, for Cheltenham C.E. Training College for Teachers.

Chester-le-Street. Proposed: 88 houses, Birtley, by Peter Clark Ltd., East Harrington, Sunderland.

Coventry. Planned: foundry, Rowleys Green, for Phoenix Castings Ltd., Grove St. C.C. propose £70,570 extensions and alterations to abattoir. £72,000 hostel for mentally disordered, Torrington Ave.

Crawley. D.C plans £450,000 entertainment centre, High St, New Town. Architect: Robert S. Grinling, Hanklin St, S.W.1.

Cromer. L. E. G. Hunt, Cathedral St, Norwich, architect for proposed rebuilding of women's ward, Cromer and District Hospital.

Cumberland. C.C. propose 1,600-pupil comprehensive school, Egremont. County Architect, Portland Sq, Carlisle.

Dagenham. Vine and Vine, Tudor Chmbrs, Station Rd, N.22, architects for proposed J. Ellman and Sons Ltd. factory.

Darlington. Newcastle Regional Hospital Board, Benfield Rd, propose psychiatric unit, Memorial Hospital. Board architect.

Denbighshire. C.C. propose £300,000 technical college, Llandrillo-yn-Rhos. County architect.

Derbyshire. Geo. Wimpey and Co. Ltd., propose 500 houses, Mulberries estate, Allestree, near Derby.

Dewsbury. Proposed: shop/office block, Daisy Hill, by H. Pickersgill. Architects: Firth Son and Blackburn, Broadway Hse, Crackenedge La.

Doncaster. Metropolitan Railway Country Estates Ltd. propose 36 dwellings, Bawtry Rd, Bessacarr. Metropolitan Railway Surplus Land Co. Ltd., Kensal Hse, Harrow Rd, N.W.10, propose redevelopment of shop/office building.

Durham. C.C. propose £60,000 mental health centre, Aykley Heads, Durham City. County architect.

Eastbourne. B.C. proposes £51,500 junior training centre for handicapped children. Engineer.

Eastleigh. B.C. propose 26 houses, Velmore estate, Chandler's Ford. Surveyor.

Edinburgh. National Commercial Bank of Scotland propose seven-storey offices, South St/Andrew St. Cost £165,000.

Galway B.C. Tender: 44 houses, Merview estate. Architect, J. Sheahan, 47 O'Connell St, Limerick.

Glasgow. Scottish C.W.S., Morrison St, Glasgow C.5, propose £200,000 factory, Queenslie industrial estate. Ravenscroft Properties Ltd., Charles St, W.1, propose shopping centre, Castlemilk Township Centre.

Hampton Hill. Proposed by Thorogood and Sons Ltd., Bond St, Surbiton, block of shops/offices.

Harrogate. Shop and Store Developments Ltd., George St, W.1, propose three-storey link office block, Victoria Ave.

Heanor. Proposed: extensions to foundry, Langley Mill, Cromford Rd, for Canlin and Bowmer.

Hereford. F. R. Bates and Son and Price, High St, Newport (Mon), architects for proposed R.C. primary school, Belmont Rd.

High Wycombe. Proposed: extensions to Elco Plastics Ltd., Desborough Park Rd. Architects: Brocklehurst, Cooper and Williamson, High St.

Hull. Hostel for mentally disordered proposed, Leeds Rd. Cost £92,888. Architect.

Hunts C.C. A. W. Ambery Ltd., Ramsey, awarded £91,457 tender for completion of Ramsey Secondary Modern School.

Leicester. Three-storey shops/showrooms, Charles St area, proposed by Shelbourne Properties to cost £100,000. Architects: Taylor Son and Bracken, London Rd, St. Albans.

Leics C.C. Proposed: £75,500 invalid home, Market Harborough. County Architect, Leicester.

Lindsey C.C. Proposed John Leggott Grammar School, Scunthorpe, to cost £298,375. New £61,600 junior school, Westcliff estate, Scunthorpe, proposed and infants' school, same estate, costing £48,125. County Architect, Lincoln.

Liverpool. Stephenson, Young and Ptnrs., Bluecoat Chmbrs, School La, architects for proposed redevelopment of central 21-acre site at probable cost of £30 million. 16-storey offices/restaurant, St. John's La, proposed by Lord St Investments. Four-storey offices, St. Paul's Sq, proposed by Liverpool Borax Co., Maxwell Hse, St. Peter's Sq. Three-storey depot/store planned, Juniper St, by Robertson, Buckley and Co., George St.

London. Fuller Electric propose extensions to Fulbourne Rd, E.17, factory, costing £200,000; architects: Elliott Cox and Ptnrs., Buckingham Palace Rd, S.W.1. Factory/warehouse, High St, E.13, proposed by A. Wilson (London) Ltd.; architects: D. Stern and Ptnrs., Gloucester Pl, W.1. Glass Developments Ltd., Sudbourne Rd, propose research laboratory; architect: Brian Poulter, Stonebanks, Warlingham. N.W. Metropolitan Hospital Board, Eastbourne Terr, W.2, propose out-patients' and casualty dept., King Edward Memorial Hospital, Ealing; Board architect. Planned: hostel and laboratories for University College Medical School, Gower St and Chenies Mews. R.C. secondary school proposed, Footscray, Eltham; quantity surveyor: T. Bedford, New Bond St, W.1. Governors of Westminster School propose primary school, Westminster; architects: D. Stokes and Ptnrs., Cochrane St, N.W.8. Charrington and Co., brewers, Mile End Rd, propose nine-storey offices, High St South, East Ham, E.6. Dove Bros. Ltd., Cloudesley Pl, N.1, contractors for £300,000 University of London students' hostel, Guildford St.

Manchester. £400,000 extensions to Shirley Institute, Didsbury, proposed by British Cotton, Silk and Man Made Fibre Assn. Lancs C.C. propose technical high school for girls, Withington.

Margate. Proposed: extensions to P. and E. Components factory, Gordon Rd, Westwood.

Peterborough. Planned: factory, Padholme Rd, for F. W. Wheatley Ltd., of that address; pelt pickling factory, Fengate, for Shaw and Allen, Fengate; extensions to experimental dept., Westfield Rd, for Baker Perkins.

Reigate B.C. Tender: 18 dwellings, Woodhatch Farm estate. Engineer.

St. Pauls (Cray). H. W. Sullivan Ltd., electrical engineers, Leo St, S.E.15, propose new factory.

Salford. A. Monck and Co. Ltd., Padgate, Warrington, contractors for proposed £675,000 Colgate-Palmolive factory extensions, Ordsall La.

Salisbury. Proposed by Diocesan Council of Education, new primary schools, Aldbourne, Dorchester and Shillingstone; new secondary school, Puddletown; and extensions to three-form-entry school, St. Adhelm's, Sherbourne.

Seaton Valley U.D.C. Tender: 32 houses, Seghill. Surveyor, Seaton Delaval.

Southend-on-Sea. Proposed: 15-storey flats, Imperial Hotel site, Westcliff, at cost of £350,000. Architect: D. S. Lichtig, Sparleaze Hill, Loughton. County and Urban Properties Ltd. propose £250,000 offices, main square, at the Civic Centre.

Staveley U.D.C. Tender: 80 three-bedroomed dwellings, Middlecroft estate. Engineer.

Stockport. Nurses' Outfitting Assn., King St, Manchester, propose three-storey showroom/offices with factory, The Hawthornes. Three-storey admin. building, Broadstone Wks, Broadstone Rd, proposed by G.E.C., Victoria Bridge, Manchester 3.

Stockton. Fordy and Son, Boathouse La, contractors for £165,000 St. Bede's R.C. secondary modern school.

Strabane U.D.C. Tender: 97 dwellings, Bradley's Field. Quantity Surveyors: F. H. Wright and Ptnrs., Botanic Ave, Belfast 7.

Stretford. A.E.I. Ltd., Trafford Park, Manchester, propose overspeed testing house/machine hall, Westinghouse Rd.

Sunderland T.C. Eight electric street lighting schemes, costing £21,000, proposed. Surveyor.

Surrey. County E.C. propose improvements to Walsh Memorial and Heathmore C.E. schools, Ash; Alfold C.P. School, Warncombe C.E. schools, Godalming; Bagshot Lea Secondary School, Farnham; and Bushy Hill School, Guildford. County Architect, Kingston upon Thames.

Wakefield. H.M. Prison Commissioners propose extensions to Imperial Training College. Architects: Graham Crump and Denis Crump, George St, Croydon, Surrey. Wightman and Bullen, Rodney St, Liverpool, architects for proposed Barnsley Rd school.

Wanstead and Woodford B.C. Tender: 81 flats, various sites. Surveyor, Woodford.

Warwickshire. C.C. propose £53,252 new Abbots Farm County Junior School, Rugby. £190,764 new South West High School, Rugby, proposed. County Architect, Warwick.

Watford. M.E. Developments Ltd., Greycaines, Bushey Mill La, propose factory/offices, Hill Farm Ave.

West Bromwich. Planned: extensions to works for maintenance/machine shop/stores, for J. H. Lavender and Co. Ltd., Crankhall La.

Whitchurch. Rowland Sanwitch and Co. Ltd., Wick Hill, Bracknell, propose new factory.

Withernsea U.D.C. Tender: 122 "Holmeville" houses and bungalows, Clovelly housing site. Surveyor.

Wolverhampton. Birmingham Regional Hospital Board, Edgbaston, award £162,613 contract for operating theatre block, Royal Hospital, to Wilson Lovatt and Sons Ltd., Clarence St.

York. Bootham Engineers Ltd., Bootham Row, propose new premises on that address.

NEW COMPANIES

Extracted from the Register issued by Jordan and Sons Ltd., 116 Chancery La, W.C.2.

Besper Electrics Ltd., 113 Nathan Way, Woolwich, S.E. Nom. cap.: £100. Permt. dirs.: Wm. C. Evans, Philip Dean and Reginald Norris.

Billman (Regulators) Ltd. Mechanical, electrical, hydraulic and electronic engineers, etc. Nom. cap.: £100. Dir.: Gerald B. Harris, 5 Staple Inn, W.C.1. Subs.: A. D. Johnson and M. Hillman, 5 Staple Inn, W.C.1.

MEETINGS TO NOTE

THURSDAY, 25 MAY

I.E.E. (Utilisation Section). "Electric Traction," J. A. Broughall. Savoy Pl, W.C.2. 5.30 p.m.

INSTITUTION OF PLANT ENGINEERS (Merseyside and North Wales). "Men, Method and Material —in that order?" K. S. London. The Blossoms, Chester. 7.15 p.m.

FRIDAY, 26 MAY

A.S.E.E. (Nottingham). Ladies' night. Grange Farm, Toton. 7 p.m.

SATURDAY, 27 MAY

INSTITUTION OF PLANT ENGINEERS (Birmingham). "Acoustics," E. G. Ewing. Imperial Hotel, Temple St, Birmingham. 7.30 p.m.

MONDAY, 29 MAY

I.E.E. SUMMER MEETING in London until 2 June.

TUESDAY, 30 MAY

INSTITUTION OF CIVIL ENGINEERS. Unwin Memorial Lecture: "The Work of the Institution's Research Committee," Professor J. F. Baker. Gt. George St, S.W.1. 5.30 p.m.

R.E.C.M.F. Show at Olympia until 2 June.

WEDNESDAY, 31 MAY

BATH AND WEST SHOW at Bristol until 2 June.

THURSDAY, 1 JUNE

ELECTRICAL CONTRACTORS' ASSOCIATION JUBILEE CONFERENCE at Torquay until 5 June.

TUESDAY, 6 JUNE

ASSOCIATION OF MINING, ELECTRICAL AND MECHANICAL ENGINEERS. Annual conference at Harrogate until 9 June.

B.T. Electrical Appliances Ltd., 167 Staines Rd, Hounslow, Mdx. Nom. cap.: £1,000. Dirs.: Leonard C. Robinson and Ivy J. Robinson.

Capitol Manufacturing (Bletchley) Ltd., Capitol Wks, Winslow, Bucks. Manufacturers of and dealers in refrigerating plant, etc. Nom. cap.: £5,000. Dirs.: Henry A. Jones and Wm. F. Button.

T. L. Carr Ltd., 95 Church Rd, Burgess Hill, Sussex. Manufacturers, importers exporters and dealers in electrical goods, etc. Nom. cap.: £100. Dirs.: Thomas L. Carr, Mrs Sally Carr and Arthur J. Dixon.

Chobham Electrics Ltd., Stanford Hse, 5 Bagshot Rd, Chobham, nr. Woking, Surrey. Nom. cap.: £5,000. Dirs.: Gerald D. Gray and Ernest R. Goodchild.

Conductors Ltd., 15a-17 Brecknock Rd, N.7. Manufacturers of and dealers in copper and other metals, generally of all kinds of electrical cables and wires, etc. Nom. cap.: £100. Dirs. not named. Subs.: Peter G. Nathan and Stephen A. Fenlaugh.

Conveyancer-Raymond Ltd., Liverpool Rd, Warrington, Lancs. Manufacturers of trucks and other material handling equipment, and to sell and distribute such trucks and equipment in the United Kingdom and elsewhere; to enter into an agreement with Raymond Corporation of Green, New York, U.S.A., which is referred to in paragraph 20 of Heads of Agreement between Conveyancer Ford Trucks Ltd., of Liverpool Rd, Warrington; and the said Raymond Corporation. Nom. cap.: £50,000. Dirs.: Alfred G. Beech Owen, Chas. W. Sharp, Geo. G. Raymond and Leslie Rumley.

Cook and Dawson Ltd., Western Approach, South Shields, Co. Durham. Electrical contractors and engineers, etc. Nom. cap.: £3,000. Dirs.: Alan Cook and Margaret H. Cook.

L. G. Cook (Mobilec) Ltd. To take over business known as "Cook Bros." carried on at Folkestone, by Leslie G. Cook, and to carry on business of manufacturers of and dealers in radio, electrical and mechanical apparatus, etc. Nom. cap.: £1,000. Dirs.: Leslie G. Cook, 100 Shornciffe Rd, Folkestone, Kent; Spencer F. Watts, 82 High St, Tenterden, Kent; and Elsie G. Cook.

Cornwell (Electrical Mechanical and Industrial Services) Ltd., 21 Talbot Rd, Harrow Weald, Middx. Nom. cap.: £1,000. Dirs.: Geo. H. I. Cornwell and Mrs P. M. Cornwell.

Craddock-Kellow Ltd., 64 St. Mary St, Cardiff. Mechanical, electrical and engineering components, etc. Nom. cap.: £5,000. Dirs.: Wm. J. Craddock and Samuel C. Kellow.

H. P. Dawson (Electrics) Ltd., 110 East St, Farnham, Surrey. Nom. cap.: £100. Dirs.: Herbert P. Dawson and Mrs Anne E. Dawson.

Dependable Electrics Ltd., 6 Surrey St, W.C.2. Manufacturers of and dealers in vacuum cleaners, etc. Nom. cap.: £100. Dirs.: To be appointed by subs. Subs.: Stanley H. Lucas and Francis A. Dean.

Field Murray Ltd., 136 Hospital St, Nantwich, Ches. To take over the electrical side of the business carried on by Thos. P. Field at Nantwich, etc. Nom. cap.: £1,000. Dirs.: Thomas P. F. Field and Neil Murray.

R. C. Ford (Thame) Ltd., 1 Buttermarket, Thame. Electrical contractors, etc. Nom. cap.: £3,000. Dirs.: Raymond F. C. Ford and Joyce B. Ford.

Foreness Electrics Ltd. To carry on business of electricians, etc. Nom. cap.: £500. Dirs.: Ernest A. A. Gosling and Charles A. Phipps.

Glix Machine Co. Ltd., 43 St. Paul's St, Leeds 1. Manufacturers of and dealers in electrical goods, etc. Nom. cap.: £100. Dirs.: Mrs Esther M. Glick and Harold E. Glick.

R. V. Griffiths (Electrical) Ltd., 61 Birkbeck Rd, N.W.7. Nom. cap.: £500. Dirs.: Reginald V. Griffiths and Elsie E. Griffiths.

J. A. Hosie Ltd., 59 Headromgate Rd, St. Annes-on-Sea, Merchants of and dealers in electrical equipment, etc. Nom. cap.: £100. Dirs.: James A. Hosie and Mrs I. Hosie.

John Kay (Electrical) Ltd., 26 High St, Melbourn, nr. Royston, Herts. Nom. cap.: £100. Dirs.: J. C. Kay and T. J. Lee.

Kenwil Electrical Distributors Ltd., 70 Bramley Ave, Coulsdon, Surrey. Nom. cap.: £500. Dirs.: Kenneth B. Wilmshurst and Sylvia M. Wilmshurst.

Lee Electric (Lighting) Ltd., 2a St. Stephens Av, W.12. Nom. cap.: £100. Dirs.: Brandon J. Lee and Brinley A. Lee.

P. T. Radmall (Electrical) Ltd., 201 Northgate St, Gt. Yarmouth. Heating installation engineers, etc. Nom. cap.: £1,000. Dirs.: Percy T. Radmall and Beryl M. Radmall.

Signray Ltd. Manufacturers and dealers in neon advertising signs, etc. Nom. cap.: £500. Dirs.: F. G. Marshall and E. Marshall, 5 Links Way, Croxley Green.

A. B. Steele (Talons) Ltd., 109 Mortimer St, Herne Bay. Civil, mechanical and electrical engineers, etc. Nom. cap.: £5,500. Dirs.: Arthur B. Steele, Mrs Ellen M. K. Steele and Major Peter Mackinnon.

S. P. Stone (Gloucester) Ltd., 28 Clarence St, Gloucester. Manufacturers of and wholesale and retail dealers in domestic household and general electrical and other equipment, including washing machines, etc. Nom. cap.: £1,000. Dirs.: Stanley P. Stone and Mrs Elizabeth A. Stone.

John Todd (Electricians) Ltd. Nom. cap.: £1,000. Dirs.: John Todd and Mrs M. Todd, 129b Ribbleton Ave, Preston; and Thomas Todd, 12 Lonsdale Rd, Preston.

Trix Electronics Ltd. To take over the business of wireless and electrical manufacturers of the Trix Electrical Co. Ltd., etc. Nom. cap.: £1,000. Dirs.: not named. Subs.: Horace S. Richardson and Chas. J. Tipton, 6 Old Jewry, E.C.

Warmsley Bros. (Import) Ltd., 216 Southampton Way, S.E.5. Electrical engineers, etc. Nom. cap.: £1,000. Dirs.: Wm. J. A. Warmsley, Frank L. Warmsley and Arthur A. Tweedy.

Westwood Electronic Components Ltd., 3 The Quadrant, Richmond, Surrey. Nom. cap.: £100. Dirs.: E. P. Westwood, J. W. Cresswell, J. E. Westwood and L. H. Sanger.

TRADE MARKS

This information is extracted from the Official Journal by permission of the Controller.

Capac. B810,949. Class 9. Cathodic protection apparatus. Englehard Industries Inc., 113 Aster St, Newark, New Jersey, U.S.A.

Collecon. 809,932. Class 9. Devices of metal and insulating material, for making electrical connections. Belling and Lee Ltd., Great Cambridge Rd, Enfield.

Cygnus. 809,491. Class 7. Electrical washing machines. Motokov Poduik Zahranicniho Obchodu, Trida Dukelskych Nrdinu 47, Prague 7, Czechoslovakia.

Digitac. 806,966. Class 9. Electric and electronic apparatus. A.P.T. Electronic Industries Ltd., 42 Bedford Avenue, W.C.1.

Friventa. 814,175. Class 9. Domestic appliances. 814,174. Class 7. Washing machines, etc. 814,176. Class 11. Refrigerators, etc. R. S. Stokvis and Zonen N.V., Heiman Dullaertplein 3, Rotterdam, Holland.

Gala. 810,377. Class 10. Heated pads, etc. A.E.I.-Hotpoint Ltd., 33 Grosvenor Pl, S.W.1.

Golden Fleece. 809,751. Class 10. Electrically heated blankets. Thermega Ltd., 37 Thurloe St, S.W.7.

Gold Star. 798,618. Class 11. Lamps. Joseph Lucas Ltd., Gt. King St, Birmingham 19.

Metromet. 808,851. Class 9. Electrical contacts, welding electrodes, and switchgear. Metro-Cutanit Ltd., Grappenhall, Warrington.

Minikron. 815,371. Class 9. Electrical fuses. Belling and Lee Ltd., Great Cambridge Rd, Enfield.

Pigeon Hole. 796,249. Class 7. Lifts, escalators, motors, etc. Pigeon Hole Parking (U.K.) Ltd., Groton Rd, S.W.18.

Prova. 812,360. Class 9. Electric wire, electric irons and other domestic utensils, batteries and bells. British Home Stores Ltd., 129-137 Marylebone Rd, N.W.1.

Ratiomatic. 816,334. Class 9. Automatic temperature controlling instruments. Rheostatic Co. Ltd., 94 Farnham Rd, Slough.

Ravolin. 816,143. Class 9. Electrical wire. Raychem U.K. Ltd., Highams Pk, E.4.

Roydazide. 817,579. Class 17. Insulating materials. Doulton and Co. Ltd., Doulton Hse, Albert Embankment, S.E.1.

Teltronic. 815,962. Class 9. Automatic control apparatus, etc. Drayton Regulator and Instrument Co. Ltd., Horton La, West Drayton.

"W" in Greek letter omega. B781,962. Class 9. Resistors and capacitors. Welwyn Electrical Laboratories Ltd., Trading Estate, Bedlington, Northumberland.

A PACKAGED STEAM SUPPLY . . . Up to 1350 p.s.i.

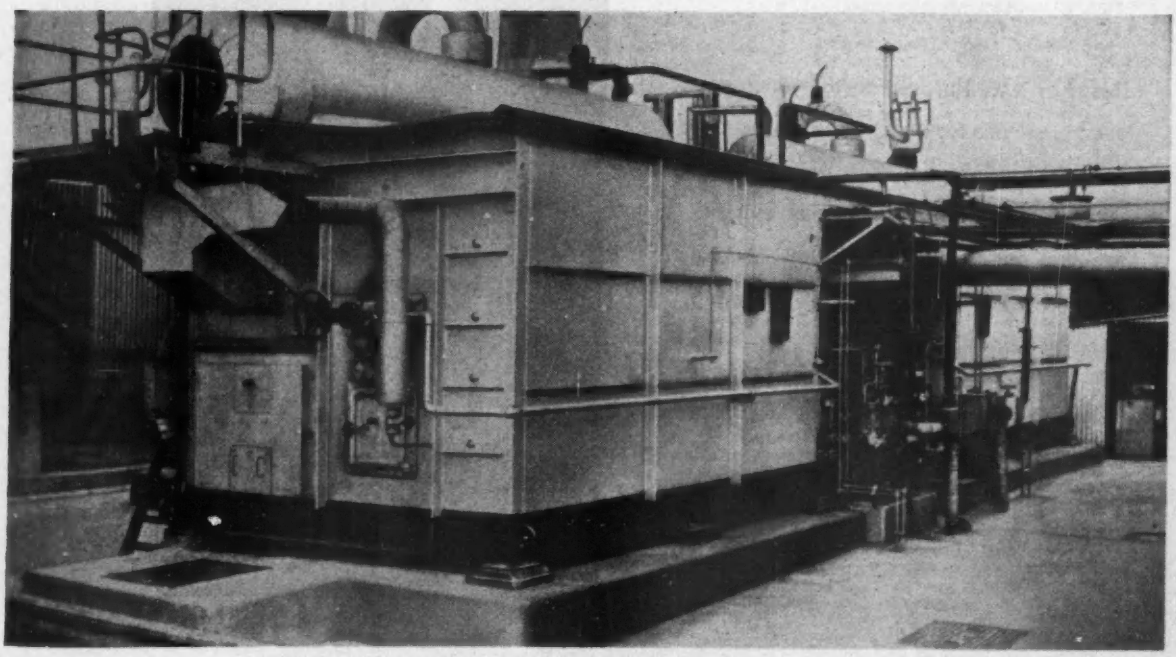
10,000—80,000 lb. of steam an hour. Temperatures up to 875°F.

These packaged steam generators offer substantial savings on installation, and generate high quality steam at low cost. They are highly efficient water-tube boilers designed to burn oil or gas separately, or in combination.

No accessories are needed : each boiler is supplied complete with its own fan, feedwater regulator, soot blowers, water column assembly and low water fuel cut-off, fully modulating combustion controls and automatic flame failure protection, and all necessary valves and fittings.

Although each of these units is complete in itself and ready for service as supplied, a range of additional equipment includes packaged economisers or air heaters, pumping and heating sets for fuel oil, control and instrument panel etc.

Full details of the Richardsons Westgarth—Foster Wheeler A.G. Series packaged steam generators will gladly be sent on request.



Foster Wheeler AG12 packaged steam generators installed for Esso Petroleum Company Limited at Trafford Park, Manchester.

RICHARDSONS WESTGARTH (HARTLEPOOL) LTD

A member of the RICHARDSONS WESTGARTH GROUP

HARTLEPOOL, CO. DURHAM and at 58 VICTORIA STREET, LONDON, S.W.1.

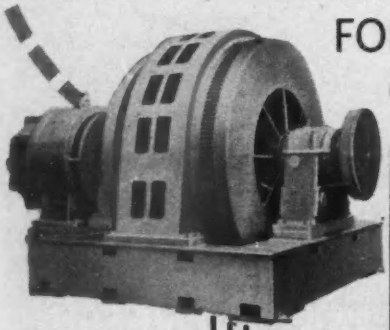
59 MOSLEY STREET, MANCHESTER, 75 BUCHANAN STREET, GLASGOW.

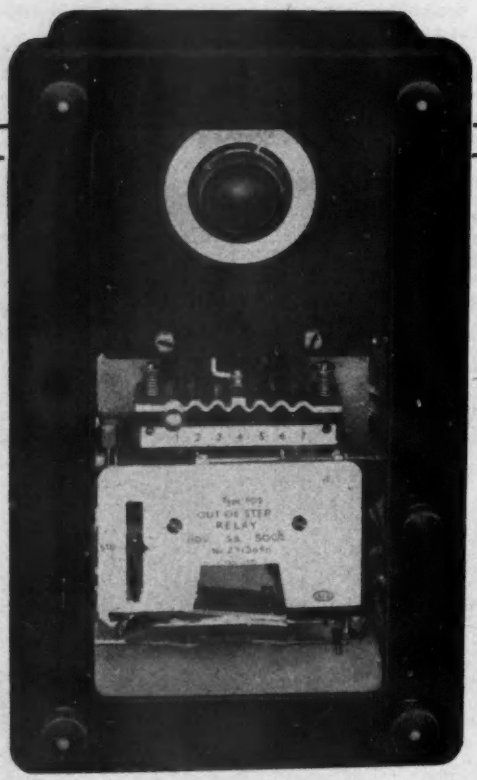
RW83

AEI INSTRUMENTATION INFORMATION SERVICE

AN IMPROVED AEI RELAY

FOR OUT-OF-STEP PROTECTION OF SYNCHRONOUS MOTORS





Based on a well-proved design which has been in service for a number of years, the type FOS relay embodies new features which render a standard relay suitable for the out-of-step production of any type of synchronous motor operating at normal power frequencies.

Full specification for type FOS relay is given in Publication 2219-1, available on request to

AEI Instrumentation Division,
Instrument and Meter Department,
Trafford Park, Manchester 17.

AEI | **Instrumentation Division**
Associated Electrical Industries Limited

ALSO: SINGLE AND POLYPHASE KWH METERS, RELAYS AND PROTECTIVE SYSTEMS, AC AND DC INDICATING INSTRUMENTS
SC/128

CLASSIFIED ADVERTISEMENTS

TENDERS INVITED

SALE BY TENDER
Million Volt Transformer and Associated Equipment

ONE Ferranti Single-phase Outdoor Type Testing Transformer, for operation on a 1,000 V single-phase, 50-cycle supply, designed to give an output voltage of 1,000 KV (R.M.S.). The transformer is nominally rated at 700 kVA for 5 minutes and is offered complete with insulating supports. Technical data:

Overall dimensions—21 ft by 19 ft by 22 ft.
Total weight—53 tons.
Weight of heaviest lift—50 tons.
Rated output—700 kVA for 5 minutes.
Maximum permissible peak voltage on secondary side—1,414 kV.
Percentage resistance—4.
Percentage reaction—20 at 50 cycles per second.

Associated equipment:
One Cooke and Ferguson type UC4 Circuit-breaker.
One heavy-duty, double-pole type CA75 Watford Contactor.
One 1 MV Wall Bushing by Micanite and Insulators Ltd.

Location: Middlesex.

Applications for Tender Forms should be made to the Ministry of Works, Disposals Section (Reference B), Room 112, Southbridge Hse, Southwark Bridge Rd, London S.E.1, by 3 June, 1961. (A 694)

GHANA SUPPLY COMMISSION

THE Ghana Supply Commission invite manufacturers to submit quotations for the following:

Ref.: ELEC.4058/1. Description: 4,600 Fluorescent Lighting Fittings complete, and Fluorescent Tubes.

Forms of Tender will be obtainable as from 22 May on payment of a fee of £1 from the Secretary, Ghana Supply Commission, P.O. Box M.35, Accra.

The closing date for the receipt of quotations will be 10 July, 1961. (A 673)

WHITCHURCH URBAN DISTRICT COUNCIL
Street Lighting Scheme-Phase II

TENDERS are invited for dismantling existing lighting points, supplying, delivering, erecting, wiring and fitting of 70 30 ft mounting height steel columns with 200 W sodium discharge lamps.

on Trunk Roads A41 and A49 in the Urban District of Whitchurch in accordance with the Plan, Schedule, Specification and Bills of Quantities prepared by the Council's Engineer and Surveyor from whom Tender Documents are obtainable upon receipt of a cheque for two guineas being a deposit which will be returned upon receipt of a bona fide tender and the return of all documents.

Tenders, in plain sealed envelopes endorsed "Street Lighting," to be delivered to the Clerk of the Council not later than 12 noon on Saturday, 17 June, 1961.

The Council do not bind themselves to accept the lowest or any tender.

FRANK CLAYTON,
Clerk of the Council.

Pauls Moss, Dodington,
Whitchurch, Shropshire. (A 730)

BOROUGH OF HESTON AND ISLEWORTH
Street Lighting Improvement
Bath Road (A.4) Dual Carriageway
Centre Reservation

TENDERS are invited for the provision and erection on the centre reservation of Bath Rd (A4), from Henly's Corner to Cranford Bridge, of Group "A" lighting, 23 double-arm and 6 single-arm columns together with 52 400 W colour-corrected mercury fluorescent, aero-screened lanterns with control gear. On deposit of £2 2s (returnable if a bona fide tender is received and not withdrawn) the Bill of Quantities, Specification and Form of Tender may be obtained from, and the Conditions of Contract and Drawings seen at the Borough Engineer's Department, 88 Lampton Rd, Hounslow. Tenders in endorsed envelopes supplied, not indicating the sender, must be delivered to me by 10 a.m., 8 June, 1961. The Corporation is not bound to accept any tender.

D. MATHIESON,
Town Clerk.

Town Hall,
Hounslow, Middx. (A 716)

TENDER

Tenders are invited for the supply and laying of approximately 20 nautical miles of 33,000 V gas-filled Submarine Cable between the islands of Trinidad and Tobago.

Specifications may be obtained on writing to the Purchasing Officer, Trinidad and Tobago Electricity Commission, P.O. Box 121, Port-of-Spain, Trinidad W.1. Closing date for Tender: 31 July, 1961. (A 729)

THE COUNTY COUNCIL OF THE COUNTY OF LANARK:
Edinburgh–Glasgow Trunk Road
(1)–Salsburgh A.8.
(2)–Harthill A.8.

(1) 42—140 watt Sodium Discharge Lanterns, totally enclosed and suitable for housing auxiliary gear. Lanterns to be supplied fitted with auxiliary gear.

(2) (a) 50—140 watt Sodium Discharge Lanterns, totally enclosed.
(b) 50—Totally enclosed Transformers.
(c) 50—Totally enclosed Capacitors.

Tenders will be considered for the whole or any part of the equipment, and the County Council does not bind itself to accept the lowest or any tender. Manufacturers desirous of tendering should make application for the tender documents to the Assistant Engineer (Lighting), 23 Beckford St, Hamilton.

Tenders will not be considered unless enclosed in a plain sealed envelope marked "Tender for Trunk Road Lighting," and must be delivered to the County Clerk, P.O. Box No. 1, Lanarkshire Hse, 191 Ingram St, Glasgow C.1, not later than Friday, 16 June, 1961.

IAN V. PATERSON,
County Clerk.
(A 695)

BOROUGH OF ILFORD
Surplus Equipment

OFFERS are invited for the following:
1. No. Crypton Electric Generator. Input 460 V D.C. Output 75 V, 30 amps D.C.
1 No. Control Panel with Voltmeter 0-100 V and Ammeter 0-200 amps.
1 No. Starter for the above Generator.
2 No. Strand Resistances for Arc Lamps 10-30 amps.

The above equipment is in good condition and may be inspected at the Public Baths, High Rd, Ilford, by arrangement.

All offers to be addressed to the Borough Engineer and Surveyor, Town Hall, Ilford, in a plain envelope marked "Tender for Surplus Equipment." Closing date 16 June. (A 696)

APPOINTMENTS VACANT

CENTRAL ELECTRICITY GENERATING BOARD
North Eastern and Yorkshire Region
MAINTENANCE ENGINEER (MECHANICAL)
THORNHILL POWER STATION

APPLICATIONS are invited for the appointment of Maintenance Engineer (Mechanical) at Thornhill Power Station.

Applicants should have experience in the maintenance of modern power station equipment, with suitable technical qualifications.

The salary for the appointment will be in accordance with the National Joint Board Agreement, Grade 6, Class H, Schedule A (£1,275/£1,410 per annum).

Forms of application may be obtained from the Assistant Regional Secretary (Personnel), Central Electricity Generating Board, North Eastern and Yorkshire Region, 1 Whitehall Rd, Leeds 1, to whom they should be returned to arrive not later than 9 June, 1961. (A 718)

ADMINISTRATIVE COUNTY OF LEICESTER
ASSISTANT ELECTRICAL ENGINEER
£960/£1,310

CANDIDATES must be Associate Members of the Institution of Electrical Engineers or be in possession of the Higher National Certificate and be experienced in the design of electrical installations for all types of buildings. Removal expenses and lodging allowance may be paid to a married man. Apply on form available from the County Architect, 123 London Rd, Leicester. (A 568)

CENTRAL ELECTRICITY GENERATING BOARD
Midlands Project Group
SECOND AND THIRD ASSISTANT ENGINEERS (ELECTRICAL)

APPLICATIONS are invited for the appointments of Second and Third Assistant Engineers (Electrical) in the Midlands Project Group at Bournville.

Applicants should preferably be Corporate Members of the Institution of Electrical Engineers or have qualifications admitting thereto and should have experience in the design, manufacture and installation of modern power station electrical plant.

Duties will involve the preparation of specifications, examination of tenders and general contract development work and correspondence.

The salary will be within Grade 5, Scale 15, £1,400/£1,830 per annum for the Second Assistant Engineer and Grade 7, Scale 13, £1,285/£1,610 per annum for the Third Assistant Engineer.

Applications should be submitted to the Administrative Officer, Midlands Project Group, P.O. Box 314 Birmingham 30, not later than 12 June, 1961.

Envelopes should be marked "Confidential—Staff Vacancy No. MPG.38/61." (A 691)

Advertisements should be sent to the Classified Advertisement Dept., Electrical Times, Sardinia House, Sardinia Street, London, W.C.2, before 10 a.m. on TUESDAY of the week of issue. Official Displayed Advertisements are charged at 46s. per inch, and all other classified advertisements at 3s. 6d. per line. Situations Wanted four insertions at twice the single insertion rate. Fee for Box Number and postage on replies 2s.

CENTRAL ELECTRICITY GENERATING BOARD

APPLICATIONS are invited for the following superannuable post. Conditions of service in accordance with N.J.B. Agreement, Schedule B. Salary includes London Allowance.

FOURTH ASSISTANT ENGINEER
(DRAWING OFFICE)
CONSTRUCTION SECTION
GENERATION DEPARTMENT
GENERATION HOUSE
Vacancy No. 61/308.

Candidates should have had a good technical education and possess O.N.C. (Electrical) or equivalent. Also experience in the layout of generating plant and associated equipment, general power supplies, heating and lighting, calculations, multicore cable schedules, together with schematic wiring diagrams. Some knowledge of the preparation of 132 kV Grid substations would be an advantage. Salary: BX, Grade 11, £905/£1,215 per annum. Point of entry would depend on experience.

Applications, quoting vacancy number, may be to (or on form from) Personnel Department, Central Electricity Generating Board, P.O. Box No. 136, Generation Hse, Great Portland St, W.1, to be received not later than 6 June, 1961. (A 697)

ADMIRALTY

Navy Works Department

VACANCIES FOR MAIN GRADE MECHANICAL ENGINEERS AND FOR BASIC GRADE MECHANICAL AND ELECTRICAL ENGINEERS

VACANCIES exist in the Navy Works Department at Pinner (Middx) for Main Grade Mechanical Engineers, and at Pinner (Middx) and certain provincial centres for Basic Grade Electrical and Mechanical Engineers. Applications only considered from Corporate Members of the Institution of Mechanical Engineers or the Institution of Electrical Engineers.

Duties of main and basic grade Mechanical Engineers comprise design and supervision of mechanical services in Admiralty Shore Establishments (except the Royal Dockyards), such as heating, ventilating, air conditioning, cranes, machine tools, civil engineering plant, etc. Candidates should have experience in this or similar work and for Main Grade posts be at least 32 years of age.

Duties of basic grade Electrical Engineers comprise design and supervision of electrical services in Admiralty Shore Establishments (except the Royal Dockyards), such as power and lighting installations, public address, sound reproduction, fire alarm, intercom and lightning conductor equipment.

Salary for Main Grade Engineers in range £1,506/£2,010 (London rate) and for Basic Grade Engineers: £936 at age 25 to £1,258 at 34 or over. Max. £1,430 (National rate), which varies slightly up or down according to location.

Appointments temporary in first instance, but there may be opportunities later for establishment. Prospects of promotion and opportunities may arise for service overseas.

Application to Director General, Navy Works, Admiralty, Chamberlain Way, Pinner, Middx, quoting "Staff/45.96.116." (A 709)

CENTRAL ELECTRICITY GENERATING BOARD

South Western Division

ASSISTANT STATION CHEMIST
Vacancy Notice: ET/AV/49/61.

REQUIRED at Plymouth "A" and "B" Generating Stations.

Superannuation Scheme. Salary: N.J.B. Class K, Grade 3, Scale 10, £1,190/£1,325 per annum.

Applicants should have had experience in the analysis of coal, oil fuel, oil and water. Experience in the control of staff would be an advantage.

Possession of Higher National Certificate in Chemistry or an equivalent qualification desirable.

Applications on form AE6/ACT obtainable from the Divisional Secretary, 26 Oakfield Rd, Bristol 8, should be completed and returned by 5 June, 1961. (A 665)

YORKSHIRE ELECTRICITY BOARD

No. 5. (Wakefield) Sub-Area

BARNSLEY DISTRICT
THIRD ASSISTANT DISTRICT ENGINEER

APPLICANTS should have had a sound practical training and some experience in the construction, operation and maintenance of H.V. and M.V. overhead and underground distribution networks, substation plant and ancillary equipment.

Candidates must be prepared to reside in the District and undertake standby duties.

Salary: N.J.B. Class J, Grade 9 (Scale 9), £1,115/£1,245 per annum.

Applications, together with the names of two referees, should be sent to the Manager, No. 5 (Wakefield) Sub-Area, Yorkshire Electricity Board, 1a Denby Dale Rd, Wakefield, not later than 9 June, 1961. (A 699)

CENTRAL ELECTRICITY GENERATING BOARD

North Eastern and Yorkshire Region

BLYTH "B" POWER STATION
ASSISTANT INSTRUMENT ENGINEER

APPLICATIONS are invited for the post of Assistant Instrument Engineer at Blyth "B" Power Station.

Applicants should hold a Higher National Certificate in electrical engineering, and preference will be given to those with appropriate experience in industrial electronic equipment.

As an introduction to the post the selected candidate will initially undertake the maintenance of a wide variety of electronic equipment in Blyth "A" and will transfer to full-time duty in Blyth "B" early in 1962.

The salary for the appointment will be in accordance with the National Joint Board Agreement, Schedule A, Grade 12, Class L (£1,040/£1,165), rising to Class M (£1,115/£1,245 per annum), and will commence at a point commensurate with qualifications and experience.

Forms of application may be obtained from the Assistant Regional Secretary (Personnel), Central Electricity Generating Board, North Eastern and Yorkshire Region, 1 Whitehall Rd, Leeds 1, to whom they should be returned to arrive not later than 5 June, 1961. (A 669)

CITY OF LIVERPOOL EDUCATION COMMITTEE

College of Technology, Byrom Street, Liverpool 3

PRINCIPAL: S. A. J. PARSON, B.SC.(ECON.), M.I.MECH.E., M.B.I.M.

DEPARTMENT OF ELECTRICAL ENGINEERING

APPLICATIONS are invited from suitably qualified persons for the appointment of

TWO SENIOR LECTURERS IN ELECTRICAL ENGINEERING (FULL-TIME)

Duties to commence 1 Sept., 1961, or as soon as possible thereafter.

Salary: £1,550 x £50—£1,750 per annum (1959 Burnham Technical Report). Increments within the scale may be added to the commencing salary for approved industrial or professional experience or research work of an equivalent standard.

Applicants should possess an honours degree and an appropriate professional qualification is desirable. They should be capable of teaching any two of the following subjects to Part III, I.E.E. level: Electrical Measurements, Electrical Machines, Electricity Supply, Electronic Engineering, Utilisation of Electrical Plant. Industrial and/or research and teaching experience is essential.

An interest in control systems would be an added advantage. The persons appointed would be encouraged to undertake research and would be expected to organise postgraduate courses.

Application forms (returnable by 5 June, 1961) and further particulars from H. S. Magnay, M.A., Director of Education, 14 Sir Thomas St, Liverpool 1.

THOMAS ALKER,
Town Clerk and Clerk to the Local Education Authority.
(A 689)

CENTRAL ELECTRICITY GENERATING BOARD

Midlands Project Group

SECOND AND THIRD ASSISTANT ENGINEERS (MECHANICAL)

APPLICATIONS are invited for the appointments of Second and Third Assistant Engineers (Mechanical) in the Midlands Project Group at Bournville.

Applicants should preferably be Corporate Members of the Institution of Mechanical Engineers or have qualifications admitting thereto, and should have experience in the design, manufacture and installation of modern power station mechanical plant.

Duties will involve the preparation of specifications, examination of Tenders and general contract development work and correspondence.

The salary will be within Grade 5, Scale 15, £1,400/£1,830 per annum for the Second Assistant Engineer and Grade 7, Scale 13, £1,285/£1,610 per annum for the Third Assistant Engineer.

Applications should be submitted to the Administrative Officer, Midlands Project Group, P.O. Box 314, Birmingham 30, not later than 12 June, 1961.

Envelopes should be marked "Confidential—Staff Vacancy No. MPG.37/61." (A 690)

SOUTH OF SCOTLAND ELECTRICITY BOARD

Edinburgh and Borders Area

INSTALLATION ENGINEER
EDINBURGH WEST DISTRICT

APPLICATIONS are invited for the appointment of an Installation Engineer for the Edinburgh West District.

Applicants should have a good knowledge of the organisation and operation of a contracting department, including estimating and costing, and be familiar with domestic, commercial and industrial installation work.

Applicants should possess the minimum qualification of the Ordinary National Certificate in Electrical Engineering.

The conditions of service will be regulated by the National Joint Board Agreement and the salary will be in accordance with Class G, Grade 9, Salary Scale No. 7, £965/£1,090 per annum.

Applications, on the standard form, should be submitted to the undersigned not later than 9 June, 1961.

C. H. A. COLLYNS,
Manager.

52 Melville St,
Edinburgh 3. (A 683)

SOUTHERN ELECTRICITY BOARD

ASSISTANT ENGINEER
(MAINTENANCE AND OPERATION)

GREENFORD District of No. 1 (Southall) Sub-Area. Salary N.J.B. Class H, Grade 10 (£1.015/£1,140 per annum, inclusive of London Allowance). N.J.B. Conditions of Service.

The duties of the post will be to assist with the maintenance and operation of switchgear, transformers, cables and overhead lines up to and including 11 kV. The appointment will involve standby duties. Housing accommodation may be available.

Applications on forms obtainable from the Sub-Area Secretary, 2-6 Windmill La, Southall, Middlesex, and returned to him quoting Z.1355, not later than 5 June, 1961.

GENERAL ASSISTANT ENGINEER

Melksham District of No. 2 (Newbury) Sub-Area. Salary N.J.B. Class G, Grade 14, £670/£805 per annum, maximum of Grade 13. N.J.B. Conditions of Service.

The duties of the post will be to assist with distribution including minor construction work and general maintenance of H.V. and L.V. overhead and underground distribution systems, substation plant, etc. Applicants should possess suitable technical qualifications.

Applications on forms obtainable from the Sub-Area Secretary, 7 Oxford Rd, Newbury, Berks, and returned to him, quoting Z.1326, not later than 5 June, 1961.

The successful candidates for the above appointments will be required to contribute to the Electricity Supply (Staff) Superannuation Scheme, if eligible. (A 700)

EASTERN ELECTRICITY BOARD

Essex Sub-Area

SOUTHEND DISTRICT

(a) THIRD ASSISTANT ENGINEER
126/61.N.

(b) FOURTH ASSISTANT ENGINEER
127/61.N.

CANDIDATES should have had a sound technical training and suitable experience in the construction, operation and maintenance of H.V. and L.V. distribution systems including substations.

Salary: (a) N.J.B. Class H, Grade 9, £1,040/£1,165; (b) N.J.B. Class H, Grade 11, £890/£1,015.

(Subject to formal confirmation the Southend District will be reclassified from 1 April, 1961, in which case the salary for the above appointments will be as follows: (a) N.J.B. Class J, Grade 9, £1,115/£1,245; (b) N.J.B. Class J, Grade 11, £965/£1,090.)

Apply by letter to J. Linton, A.H.W.C., M.I.E.E., A.I.MECH.E., Manager, Eastern Electricity Board, 85 London Rd, Southend-on-Sea, by 9 June, 1961.

FOURTH ASSISTANT ENGINEER
(METER TESTING)
SUB-AREA HEADQUARTERS
125/61.R.

Applications are invited for the above appointment in the Meter and Testing Section based at Havana Close, Romford.

Duties will include commissioning, testing, maintenance and repair of metering equipment.

Candidates who may not have specialist experience but possess a good technical background will receive consideration.

Salary: N.J.B. Class L, Grade 13 (£965/£1,090), plus London Allowance.

(Subject to formal confirmation the Sub-Area will be reclassified from 1 April, 1961, in which case the salary for this appointment will be N.J.B. Class M, Grade 13 (£1,040/£1,165), plus London Allowance.)

Apply by letter to C. C. Brazier, A.M.I.E.E., Engineer, Essex Sub-Area, Eastern Electricity Board, "Millfield," Bentley, near Brentwood, Essex, by 9 June, 1961.

Fens Sub-Area

CAMBRIDGE BRANCH
SENIOR COMMERCIAL ASSISTANT
124/61.R.

Candidates should have full knowledge of modern installation practice and be able to design and prepare specifications and competitive quotations for all classes of commercial and industrial installations including thermal storage heating and floor-warming. Experience in the general supervision of contracting work is also necessary.

Salary: N.J.C. Grade 4, £890/£1,010.

Apply by letter to the Manager, Fens Sub-Area, Eastern Electricity Board, Milton Hall, Milton, Cambridge, by 9 June, 1961.

Suffolk Sub-Area

BURY ST. EDMUNDS DISTRICT
DEMONSTRATOR
123/61.R.

Candidates should have had domestic science training including electrical housecraft; should hold the E.A.W. Certificate and be competent to plan and give cookery demonstrations including lectures and advice to consumers on the utilisation of domestic electrical apparatus.

Salary: N.J.C. Grade 1, £600/£700.

Apply by letter to H. B. Rendle, A.M.I.E.E., Manager, Bury St. Edmunds District, Eastern Electricity Board, 4 Cornhill, Bury St. Edmunds, Suffolk, by 19 June, 1961. (A 723)

COUNTY BOROUGH OF BLACKPOOL

APPLICATIONS invited for appointment of a

SENIOR TECHNICAL ASSISTANT
(APT. III/IV—£960/£1,310).

Candidates should hold qualifications of Grad. I.E.E. or similar standard, and have experience of specification drafting and contract supervision for lighting and electrical installations and knowledge of distribution networks.

Application form and conditions from Director of Lighting and Electrical Services, Rigby Rd East, Blackpool, to whom they should be returned by 30 May, (A 615)

CENTRAL ELECTRICITY GENERATING BOARD

South Wales Division

APPLICATIONS are invited for the following superannuable N.J.B. appointments in the South Wales Division:

ASSISTANT ENGINEER
(COMBUSTION AND EFFICIENCY)
NEWPORT POWER STATION, MON.
VACANCY No. 109/ET/61.

Salary: Schedule A, Class F, Grade 7, Scale 8, £1,040/£1,165 per annum.

Applicants should possess H.N.C. or equivalent qualifications. Power station experience and knowledge of automatic combustion control equipment desirable.

The following appointments in the Construction Section, Divisional Transmission Department, Cardiff, will be based at Cardiff for the time being, but may be transferred to Regional Office, Bristol, before the end of the present year.

THIRD ASSISTANT ENGINEER
(PROGRAMMES AND PROGRESSING)
VACANCY No. 110/ET/61.

Salary: Schedule B, Class AX, Grade 6, Scale 12, £1,285/£1,500 per annum.

Applicants should possess an appropriate electrical engineering qualification and have had experience of programming and progressing, from the design stage to final commissioning, of schemes involving the construction of 132 kV and higher voltage transmission substations and overhead lines. The successful candidate will be required to collaborate with the Engineers engaged on design, contract letting and site supervision to ensure that all schemes are completed within the programmed times.

Duties will include the preparation of programme schedules for all contracts associated with each scheme, the maintenance of progress records and charts as the work proceeds, and the compilation and analysis of interim and final costs.

Experience in the site supervision of contract works of a similar nature would be an advantage.

SECOND ASSISTANT ENGINEER (CIVIL)
VACANCY No. 111/ET/61.

Salary: Schedule B, Class AX, Grade 5, Scale 13, £1,375/£1,610 per annum.

Applicants should possess an appropriate civil engineering qualification and have experience in the design and construction of civil engineering works, buildings and piling.

Duties will include estimating of costs, drawing up of specifications, examination of tenders, preparation of recommendations for the release of contracts for transmission substations of 132 kV and higher voltage, site surveys and the supervision of site construction works. Applicants should have a knowledge of the design of reinforced concrete foundations and structures.

Special application forms obtainable from Divisional Secretary, Central Electricity Generating Board, South Wales Division, Twyn-y-fedwen Rd, Gabalfa, Cardiff, to be returned by 9 June, 1961. (A 722)

CENTRAL ELECTRICITY GENERATING BOARD

South Thames Division

ELECTRICAL ENGINEERS' DEPARTMENT
NORTHFLEET DISTRICT
Vacancy No. 147/61.
THIRD ASSISTANT ENGINEER
(SERVICES)

CANDIDATES must possess Higher National Certificate in Electrical Engineering or equivalent qualification and have had experience of the commissioning and maintenance of automatic protective gear and control gear of the type associated with major electrical plant in the Generating Board's power stations and substations, and of investigating faults on such plant.

Ability to make calculations of balanced and unbalanced fault conditions and to write a good report is also desirable.

Salary: N.J.C. Class AX, Grade 8, £1,155/£1,375 per annum, including London Allowance and subject to review.

Applications giving age, details of experience, qualifications, etc., should be sent to the Personnel Officer, Central Electricity Hse, Lower Ham Rd, Kingston upon Thames, Surrey, to arrive by 9 June. (A 721)

MIDLANDS ELECTRICITY BOARD

APPLICATIONS are invited for the following superannuable post:

North Staffordshire Area:

FOURTH ASSISTANT ENGINEER
(PLANNING) (AREA OFFICE)

Applicants should have had general distribution experience, and duties will include detailed design of major substations, specifications for substation equipment, planning and estimating for system extensions. Technical qualifications desirable. Salary: £965/£1,090 per annum (N.J.B. Grade L.13). Apply, by letter, within ten days, stating age, qualifications, experience, present position and salary, to Mr C. C. Pimble, Area Manager, Midlands Electricity Board, 234 Victoria Rd, Fenton, Stoke-on-Trent. (A 710)

CAMBRIDGE TECHNICAL COLLEGE AND SCHOOL OF ART

SENIOR MAINTENANCE ELECTRICIAN

REQUIRED as soon as possible. Duties will include planning and maintenance of wiring circuits and servicing of a variety of electrical equipment throughout the College, and will entail responsibility for ordering materials, keeping stock records, and supervising the work of part-time assistants and of outside contractors.

Salary on scale £555/£825, according to qualifications and experience.

Applications, giving full particulars of age, education and appropriate experience, together with the names of two referees (preferably former employers), should be sent to the Principal, Cambridgeshire Technical College and School of Art, Collier Rd, Cambridge. (A 693)

THE EAST MIDLANDS ELECTRICITY BOARD

APPOINTMENT OF CHIEF ENGINEER

THE East Midlands Electricity Board invite applications for the post of Chief Engineer to the Board to succeed Mr A. G. Connell, M.I.E.E., M.I.MECH.E., F.INST.F., on his retirement in November, 1961.

Candidates must be Corporate Members of the Institution of Electrical Engineers and should have had wide experience in a large electricity supply organisation.

The salary for the appointment will be between £4,000 and £4,750 per annum.

Applications giving full details of age, qualifications, experience, present position and salary should be forwarded to the Chairman of the Board at Mapperley Hall, Lucknow Ave, Nottingham, to arrive not later than 12 June, 1961. (A 708)

CENTRAL ELECTRICITY GENERATING BOARD

Midlands Region
West Midlands Division

ASSISTANT ENGINEER (DISTRICT)

FOURTH Assistant Engineer is required in the Birmingham Transmission District.

N.J.B. Agreement conditions, superannuable appointment, salary within Schedule B, Class BX, either Grade 9, 10 or 11, according to qualifications and experience. The salary ranges are as follows:

Grade 9: £1,005/£1,325 per annum.
Grade 10: £935/£1,245 per annum.
Grade 11: £855/£1,165 per annum.

Candidates should possess a Higher National Certificate in Electrical Engineering, or an equivalent qualification and should preferably have had some experience on any type of equipment associated with E.H.V. transmission.

Apply quoting Vacancy No. 140/61MD, on form AE6, available from the Establishments Officer, 53 Wake Green Rd, Moseley, Birmingham 13, to reach him not later than 5 June, 1961. (A 705)

THE SOUTH WALES ELECTRICITY BOARD

APPLICATIONS are invited for the following positions:

Cardiff and East Central Area

(a) GENERAL ASSISTANT ENGINEER
RHONDDA DISTRICT
(Ref. 68/61/ET.)

The duties of this post will be of a general nature and preference will be given to Engineers possessing the Higher National Certificate in Electrical Engineering.

Salary: N.J.B. Class F, Grade 11, Scale 4 (£765/£870 per annum).

(b) DISTRICT ENGINEER
MERTHYR AND ABERDARE DISTRICT
(Ref. 70/61/ET.)

The successful applicant will be responsible to the District Manager for the planning, development, construction, operation and maintenance of an Urban and Rural Distribution System; also for the preparation of Schemes and Estimates and the control of Capital and Revenue Expenditure.

The District covers an area of 120 square miles and serves 45,000 consumers, being varied in its character and with an important industrial component in addition to Rural and Urban load.

Candidates should possess an extensive knowledge and wide experience of the Engineering side of the Industry and be capable of administering a large department comprising Technical, Clerical and Manual employees.

Preference will be given to Graduates or Corporate Members of the Institution of Electrical Engineers.

Salary: N.J.B. Class G, Grade 2, Salary Scale 14, £1,535/£1,720 per annum.

Applications stating age, present position, present salary, qualifications, experience, and endorsing envelope with the appropriate reference, should be addressed to C. L. Townsend, ASSOCIATE I.E.E., Manager, Cardiff and East Central Area, Colchester Ave, Cardiff, to arrive not later than 17 June, 1961.

R. G. WILLIAMS,
Secretary.
(A 725)

CENTRAL ELECTRICITY GENERATING BOARD
West Midlands Division

ASSISTANT ENGINEER (RELIEF)

REQUIRED at Wolverhampton Power Station. N.J.B. service conditions, superannuable appointment, salary within Schedule A, Grade E.12, £670/£750 per annum.

The engineer will be expected to carry out shift relief duties and when not so employed will be available to undertake duties in the maintenance and operation departments. Shift allowance as laid down in the N.J.B. Agreement will be paid when shift duties are worked.

Applicants should have received a sound technical training and appropriate qualifications will be an advantage.

Apply, quoting vacancy no. 145/61MD, on form AE6, available from the Station Superintendent, Wolverhampton Power Station, Commercial Rd, Wolverhampton, to whom they should be returned when completed not later than 5 June, 1961. (A 727)

SOUTH EASTERN ELECTRICITY BOARD

ASSISTANT
(EXPENDITURE AND ADMINISTRATION)
BRIGHTON AND HOVE DISTRICT

N.J.C. Grade 7, £1,250/£1,355 p.a. Applicants must have extensive practical knowledge and experience of District clerical work. They should be accustomed to the control of staff and be capable organisers and administrators. The officer appointed will be directly responsible to the Chief Clerk for the work carried out in Rechargeable and Capital Works, Wages and Stores Sections, Registry and Typing Pool, and will be regarded as the Assistant District Chief Clerk.

Applications, quoting ET and naming two referees, to District Manager, Seeboard, Electric Hse, Castle Sq, Brighton 1, by 2 June, 1961.

GEORGE WRAY,
Secretary.
(A 698)

AIR MINISTRY

ENGINEERING DESIGNER DRAUGHTSMEN REQUIRED IN LONDON

SALARY (inner London scale) Grade III, £658/£1,048 (£866 at age 25)—starting salary depends on age, quals. and exp.

Electrical Engineering Designer Draughtsmen experienced in preparation of schemes for illumination and electrical equipment of buildings or schemes for H.V. and M.V. electrical distribution (Grade III).

Candidates should have served a recognised apprenticeship or have had equiv. training and also adequate practical exp. Possession of recognised technical quaIn. an advantage—financial assistance and time off may be allowed for recognised courses of study for technical quals. Five-day week with 18 days' paid leave p.a. initially. Promotion and pension prospects. Some overseas tours with special allowances in addition to salary.

Applicants, who must be natural born British subjects, should write (quoting King's Cross A/N 803) to Air Ministry, W.G.d, Lacon Hse, Theobalds Rd, London W.C.1, or to any Employment Exchange, giving age, details of training, quals, and full particulars of former posts held. Candidates selected will normally be interviewed in London and certain expenses reimbursed. Only candidates selected for interview will be notified. (A 349)

CENTRAL ELECTRICITY GENERATING BOARD
South Wales Division

APPLICATIONS are invited for the following superannuable N.J.B. Schedule A appointments in the South Wales Division.

GENERAL ASSISTANT ENGINEER
(TRAINING)
CARMARTHEN BAY POWER STATION
BURRY PORT, CARMS.
Vacancy No. 113/ET/61.

Salary: Class K, Grade 12, Scale 7, £965/£1,090 per annum.

GENERAL ASSISTANT ENGINEER
(TRAINING)
USKMOUTH "A" POWER STATION
WEST NASH, NR. NEWPORT, MON.
Vacancy No. 114/ET/61.

Salary: Class K, Grade 12, Scale 7, £965/£1,090 per annum.

Applicants should possess H.N.C. or equivalent qualifications and have had experience of boiler house and turbine house practice.

Previous training experience an advantage.

Special application forms obtainable from Divisional Secretary, Central Electricity Generating Board, South Wales Division, Twyn-y-fedwen Rd, Gabalfa, Cardiff, to be returned by 8 June, 1961. (A 720)

CENTRAL ELECTRICITY GENERATING BOARD
East Midlands Division

ASSISTANT ENGINEER (RELIEF)
WARWICK POWER STATION
Vacancy No. 103/61.

APPLICATIONS are invited for the position of Assistant Engineer (Relief) at Warwick Power Station, Emscote Rd, Warwick.

This post offers an opportunity to gain experience in the Electricity Supply Industry in which there are excellent prospects of advancement.

Preference will be given to candidates who are at present pursuing a course of study with the object of obtaining the Higher National Certificate in Electrical or Mechanical Engineering, or a similar qualification.

Salary will be in accordance with Class E, Grade 12 (£670/£750 per annum), of the National Joint Board Agreement, and will progress ultimately to £805 per annum, plus £90 per annum whilst engaged on shift duties.

Closing date for receipt of applications: 2 June, 1961.

ASSISTANT SHIFT CHARGE ENGINEER
CASTLE DONINGTON POWER STATION
Vacancy No. 105/61.

Applications are invited for the position of Assistant Shift Charge Engineer at Castle Donington Power Station, near Derby.

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Candidates should have received a thorough practical and technical training and have had experience in the operation of modern high merit plant, together with the control of staff.

Technical qualifications leading to Corporate Membership of a professional institution will be an added advantage.

Salary will be within Class L, Grade 8 (£1,350/£1,500 per annum), of the National Joint Board Agreement, plus 10% allowance for shift duties.

Closing date for receipt of applications: 9 June, 1961.

The appointments will be pensionable within the terms and conditions of the Electricity Supply (Staff) Superannuation Scheme.

Applications should be submitted on the official form AE6/ACT which may be obtained from the Station Superintendent concerned and should be returned to him by the date stated.

O. S. WOODS,
Divisional Controller.
(A 711)

THE NORTH WESTERN ELECTRICITY BOARD

THIRD ASSISTANT DISTRICT ENGINEER
(TESTING)
BLACKPOOL DISTRICT

DUTIES will include commissioning and maintenance tests of protective gear and C.T. operated metering equipment, attention to faults on major transformer automatic voltage control equipment, earth tests, etc., and liaison with Sub-Area Testing Staff.

Preference will be given to applicants who hold the H.N.C. in Electrical Engineering.

Salary Scale: £1,115/£1,245 p.a. Grade J.9. N.J.B. Conditions.

Applications on forms to be obtained from the Manager, No. 4 Sub-Area, The North Western Electricity Board, 40-41 Lune St, Preston, and returned to him by 5 June, 1961. (A 707)

LONDON ELECTRICITY BOARD

TECHNICAL OFFICER

APPLICATIONS are invited from Chartered Electrical Engineers for the above position in the Chief Engineer's Design and Planning Branch at Lesco Hse, Stamford St, S.E.1.

Applicants should have received a good education in engineering, preferably holding a Degree, and be practised in the preparation of reports. Previous responsibility in the operation of distribution systems and experience in their design are necessary qualifications.

The post is graded under Schedule B of the National Joint Board Agreement as Grade 3, and the commencing salary within Class BX will be in the range £1,630/£2,010 per annum, inclusive of London Allowance.

Application form obtainable from the Personnel Officer, 46 New Broad St, London E.C.2, to be returned completed within 14 days of the publication date of this notice. Please quote Ref.: PER/V/3299/T. (A 726)

CENTRAL ELECTRICITY GENERATING BOARD
South Thames Division

LITTLEBROOK POWER STATION
Vacancy No. 33A/61.
ASSISTANT ENGINEER
(SHIFT OPERATION)

THE successful applicant will be responsible to the Assistant Shift Charge Engineers in the A, B or C Stations for shift work duties relating to boiler and turbine operation in the stations, with emphasis on efficient boiler house working. H.N.C. Electrical or Mechanical or equivalent qualification is preferred and some knowledge of control room work would be an advantage.

Salary: N.J.C. Class L, Grade 10, £1,359/£1,507 10s per annum, including London and shift allowances.

Applications giving age, details of experience, qualifications, should be sent to the Station Superintendent, Littlebrook Power Station, nr. Dartford, Kent, to arrive by 9 June. (A 719)

London Consulting Engineer

requires

JUNIOR ELECTRICAL DRAUGHTSMEN

Drawing office experience essential. Age up to 23. Salary £400/£650 per annum according to age and experience. Write giving full details of age, qualifications, experience and salary required.

WALTER BRIDGES AND CO.,
37 Parliament St,
Westminster, S.W.1.

(A 702)

SALES ENGINEER

required for Scotland to specialise in the sale of Accessories Division products which cover the following:

(1) Overhead Line Equipment (all voltages).
(2) Jointing and Distribution Equipment (all voltages).
(3) Telephone Distribution Equipment.
(4) Sub-Station Panels and Street Distribution Pillars.
(5) Flameproof Distribution Equipment.
(6) Traction and Bus Bar Installations.

Previous experience, though desirable, is not essential, as product training will be given if necessary. The man appointed will require initiative with a high sense of responsibility and the ability to advance within our Organisation. Applicants should be 28 to 35 years of age and hold a Degree of H.N.C. in Electrical or Mechanical Engineering.

Applications should be as detailed as possible and addressed to: Personnel Officer (Home Sales, Regions and Branches), British Insulated Callender's Cables Ltd., 21 Bloomsbury St, London W.C.1.

(A 731)

THE ELECTRICITY COUNCIL

require an

ASSISTANT STATISTICIAN

in the

Utilisation Research Section of Commercial and Development Department, at Winsley St, W.1.

Functions of the Section include investigations into development of electrical demand of domestic, commercial, industrial, etc., consumers; use of appliances; consumers' attitudes and opinions, etc., employing statistical techniques; especially sample surveys and multiple-regression analysis.

The successful candidate would preferably hold a degree in Statistics, or Statistics and Mathematics and he or she would have had appropriate experience in application of statistical methods. Knowledge of the electricity supply industry would be an advantage.

● **Salary within £1,345/£1,780 p.a. inclusive, according to qualifications and experience.**

Applications, stating age, qualifications, experience, present position and salary, to E. Landucci, The Electricity Council, Winsley St, W.1, by 10 June, 1961. Quote Ref. ET/113.

(A 686)

BRUSH

Brush Electrical Engineering Company Limited
(A member of the Hawker Siddeley Group—Industrial Division)

DRAUGHTSMEN

Transformer
Switchgear
Rotating Electrical Machines
Motor Control Gear
Electric and Diesel Electric Locomotives
(Mechanical, Control Gear & Electrical Machines)
General Engineering

If you are a qualified Draughtsman and interested in one of the above vacancies, please apply to:

Mr. A. Garner,
Brush Electrical Engineering Company Limited,
Loughborough, Leicestershire,

quoting reference PL.9943, and giving brief details of your qualifications and experience.

ALL APPLICATIONS WILL BE TREATED IN THE STRICTEST CONFIDENCE.

The Company is situated in a small town on the edge of Charnwood Forest. Extensive housing development is taking place and excellent educational facilities of all grades are available.

(A 684)

Circuit Design Engineer

required

to assist Chief Engineer in basic development of new circuits, etc., requiring new techniques.

The age bracket is not of importance but the successful applicant will be paid an excellent salary providing he can satisfy the executive of his capabilities relative to his abilities to deal with circuit problems and calculations using his initiative and experience gained in a good sphere of activity in a similar type of work.

A basic background of lift and crane control applications would be given a priority consideration.

The position would be in the London area.

Pension Fund, Canteen facilities.

Confidential replies in the first instance, giving age, experience and present salary range, should be addressed to the Personnel Officer, Box No. 8309, Electrical Times.

(A 682)

DEWHURST & PARTNER LIMITED
TECHNICAL SALES ENGINEERS

Due to expansion programme, coupled with the promotion of existing staff, the following additional staff appointments will shortly be made:

(a) Resident Engineer and Sales Manager (Western Counties).
(b) Senior Technical Representatives Manager (Western Counties).
(c) Junior Technical Representatives (Midland Counties).

All applicants must have manufacturing knowledge of automatic motor control equipment, coupled with technical background in this field. Applicants for positions (a) and (b) must have proven sales experience, and record with companies manufacturing similar types of equipment. All appointments are pensionable under the company pension fund, and in the case of positions (a) and (b) a Company car will be provided.

Confidential applications in writing in the first instance giving age, experience, qualifications and salary required, to the Personnel Officer, Dewhurst and Partner Ltd., Inverness Wks, Hounslow, Middx, stating position for which application is made.

(A 681)

J. & P.

SENIOR SALES ENGINEER

A Senior Sales Engineer is required by Johnson & Phillips Limited to promote the sale of the Company's products to major industrial concerns, and also through Consulting Engineers. He will probably be between 30 and 35 years of age and preferably a Corporate Member of the Institution of Electrical Engineers. In addition, he should have some sales experience and a technical knowledge of electrical distribution equipment. The post will be based upon the London Branch of the Company and applications giving preliminary details should be sent to the Employment Manager, Johnson & Phillips Limited, Charlton, S.E.7.

(A 715)

J. & P.

TRANSFORMER DESIGN ENGINEERS

To meet the requirements of the Company's expanding programme, Johnson & Phillips Ltd. need two or three qualified Transformer Design Engineers.

The Company's present range covers power transformers up to 45 MVA, 132 kV, and designers with experience within this range or in the design of transformers for distribution and for special applications are invited to apply. The positions offer opportunity for advancement.

Please send details of your experience, qualifications and salary to the Employment Manager, Johnson & Phillips Limited, Victoria Way, Charlton, S.E.7.

(A 703)

PHILIPS ELECTRICAL LTD.

require an

Assistant

in their South East Region Lighting Design Office, to assist in planning a wide variety of Lighting Schemes. Some knowledge of this work is necessary, but the position will give the opportunity to gain further training and experience in this field. This post offers excellent prospects in an expanding department. Please send full details to the Personnel Officer (M/699/4), Century Hse, Shaftesbury Ave, W.C.2.

(A 687)

G.E.C.

Hirst Research Centre

There is a vacancy at this modern Centre for a

Graduate PHYSICIST Electrical or Mechanical ENGINEER

to undertake work in the field of Industrial Heating. The activities embrace the development of new types of thermal storage heaters, investigations into the thermal properties of heat storage materials, and experiments concerned with sheathed wire elements, their properties, ratings, conditions of use and the effect of environment.

Candidates should preferably hold a good honours degree, but applications will be welcomed from those with a pass degree or equivalent. Relevant experience is desirable but not essential.

Please apply in writing to:

THE STAFF MANAGER
THE GENERAL ELECTRIC COMPANY LIMITED
HIRST RESEARCH CENTRE, WEMBLEY, MIDDLESEX

(Ref. RGB/278/U), giving age and brief particulars of experience and qualifications.

(A 685)

'ENGLISH ELECTRIC' CONTROL ENGINEERING

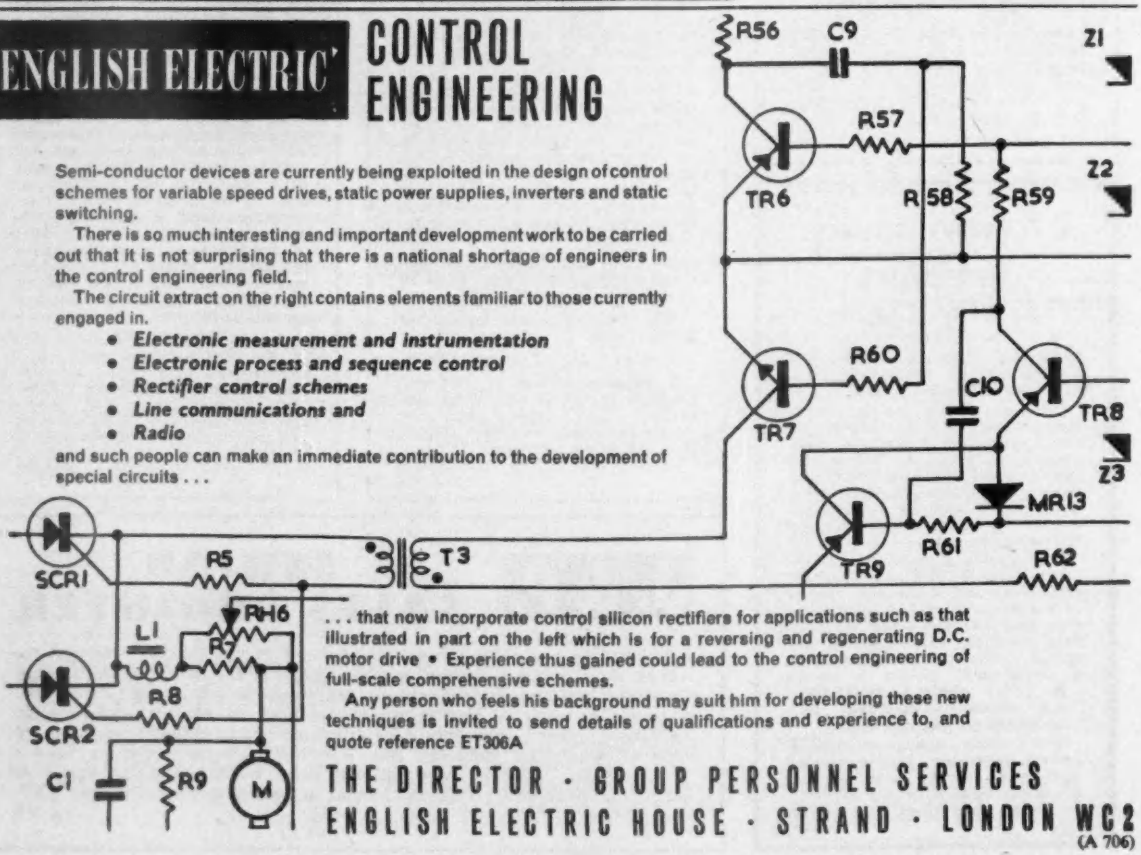
Semi-conductor devices are currently being exploited in the design of control schemes for variable speed drives, static power supplies, inverters and static switching.

There is so much interesting and important development work to be carried out that it is not surprising that there is a national shortage of engineers in the control engineering field.

The circuit extract on the right contains elements familiar to those currently engaged in.

- ***Electronic measurement and instrumentation***
- ***Electronic process and sequence control***
- ***Rectifier control schemes***
- ***Line communications and***
- ***Radio***

and such people can make an immediate contribution to the development of special circuits . . .



. . . that now incorporate control silicon rectifiers for applications such as that illustrated in part on the left which is for a reversing and regenerating D.C. motor drive • Experience thus gained could lead to the control engineering of full-scale comprehensive schemes.

Any person who feels his background may suit him for developing these new techniques is invited to send details of qualifications and experience to, and quote reference ET306A

THE DIRECTOR · GROUP PERSONNEL SERVICES
ENGLISH ELECTRIC HOUSE · STRAND · LONDON WC2

(A 706)

SOUTH OF SCOTLAND ELECTRICITY BOARD

APPLICATIONS are invited for a superannuable appointment as
ASSISTANT INSTRUMENT ENGINEER
at the Board's Nuclear Generating Station, under construction at Hunterston, near Largs, Ayrshire.

The successful candidate will be engaged on instrumentation and control equipment on both conventional and nuclear plant in the Station. A course of specialised training will be given in nuclear instrumentation and control equipment. Minimum technical standard will be the possession of a Higher National Certificate. Previous experience of power station instrumentation and control equipment desirable.

Salary: N.J.B. Class M, Gade 8, £1,440/£1,610 per annum.

Applications on the standard form, quoting Ref.: G14/61, should be returned to the Secretary, South of Scotland Electricity Board, Inverlair Ave, Glasgow S.4, not later than 9 June, 1961. (A 728)

CENTRAL ELECTRICITY GENERATING BOARD
Southern Division
THIRD ASSISTANT ENGINEER
(OPERATIONAL RESEARCH)
GENERATION DEPARTMENT
DIVISIONAL HEADQUARTERS
SEC/3.154.

APPLICATIONS are invited for the above appointment in the Operational Research Section of the Generation Department.

Applicants should hold a recognised qualification in engineering or science and have had some experience in generating stations.

Since opportunities for training will be offered to the successful applicant previous experience in operational research is not essential but the ability to apply research technique to problems involving the efficient utilisation of resources in the general field of operation and maintenance is necessary.

Salary: N.J.B. Grade AX8, £1,105/£1,325.

Application forms obtainable only from Divisional Secretary, 111 High St, Portsmouth, should be returned by 7 June, 1961. (A 717)

AUTOMATIC Electrical Control Gear manufacturers require SENIOR and JUNIOR SALES ENGINEERS for London office. Applicants for Senior positions must have Sales experience. Junior Engineers will receive training as internal, then external Sales Engineers on progressive basis. Minimum desirable qualification H.N.C. (Elec.), but those studying for this will be considered. Apply: General Sales Manager, Lee Guinness Ltd., 25 Victoria St, S.W.1. (A 640)

AN old-established cable company contemplating diversifying has vacancies for MANAGERS in the following depts.: Electronics (part and supplies), Hearing Aids (sales of finished items), Tape Recorders (sales), Radio and TV (transistors, parts and finished items to trade), Loud Hailers and P.A. (sales). Will those with qualifications in the appropriate fields interested in setting up departments (all appointments are in Sales Depts.), please give full details of their experience, age, present emoluments and sphere of activities to the Chairman, Box No. 8311, Electrical Times. (A 714)

AGRICULTURE—ELECTRICAL ENGINEER required for Grain Division—preferably with knowledge of fans and heaters as applied to grain drying. Excellent opportunity for energetic young man wishing to join rapidly expanding Company. Write, Reference W.G.C., The Simplex Dairy Equipment Co. Ltd., Sawston, Cambridge. (A 713)

CABLE JOINTERS required up to and including 33 kV. Good working conditions. Apply Box No. 8303, Electrical Times. (A 675)

Box No. replies to be addressed to the ELECTRICAL TIMES, Sardinia House, Sardinia Street, London, W.C.2

COMMERCIAL SALES ENGINEER required for service in Hong Kong with Merchant Company dealing in general electrical equipment, refrigerators, radios, etc. Good technical background and previous commercial experience essential. Age about 25; bachelor preferred. Good salary, scale according to qualifications and experience; excellent prospects. Write: Box No. 2025, c/o Abbotts, Eastcheap, London E.C.3. (A 712)

CABLE ESTIMATOR required. State age and experience.—Wandleside Cable Works Ltd., 106 Garratt La, Wandsworth, S.W.18. (A 701)

DRAUGHTSMEN required having experience of a.c. and d.c. L.T. switchgear for marine and industrial use. O.N.C. minimum. Contributory pension scheme in operation. Apply in writing only, stating age, experience and present salary, to the Chief Draughtsman, Whipp and Bourne Ltd., Castleton, Rochdale. (A 688)

ELECTRICAL ENGINEERS required for Manchester and Midlands Area, with experience in all types of cable installations, End Equipment, etc. Good salary and prospects. Superannuation Scheme. Apply Box No. 8301, Electrical Times. (A 674)

ELECTRICAL SENIOR and JUNIOR ESTIMATING ENGINEERS. First-class situations open, large Electrical Company, London. Write age, experience, salary. Box No. 8305, Electrical Times. (A 676)

EXPANDING firm of Consulting Engineers, with international reputation, require the following staff:

ASSISTANT ELECTRICAL ENGINEER. Salary range: £600/£1,000 per annum.

ASSISTANT MECHANICAL ENGINEER. Salary range: £600/£1,000 per annum.

MECHANICAL ENGINEER. Salary range: £1,000/£1,500 per annum.

Duties include the design of either electrical or heating, ventilating and mechanical services in buildings and the point of entry to salary scales is dependent on age and experience. Proved ability will be further rewarded. Luncheon vouchers and annual bonus in addition to salary. A profit sharing scheme is being evolved for Assistants and Engineers, with a superannuation scheme for Engineers only. Similar vacancies exist at our branch office in the Waterloo area. Write or telephone Steensen, Varming and Mulcahy, 146 New Cavendish St, London W.1. LANgham 6832. (A 692)

SENIOR ELECTRICAL CONTRACTING ENGINEER required, South Wales Area, deal with Contracts to final Accounts. Excellent opportunity. Write age, salary, experience. Box No. 8307, Electrical Times. (A 677)

STOREKEEPER wanted. Good conditions, Pension Scheme. Please give brief details of experience, age and present salary. Hallams (Electrical Contractors) Ltd., 143 Buxton Rd, Stockport, Cheshire. (A 642)

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6 Stratton St, London W.1.
Tel.: GROsvenor 7807-8.
(A 704)

LIVE TECHNICAL REPRESENTATIVE (H.N.C.) seeks agencies S.W. Lancs.—Box 8299, Electrical Times. (A 631)

MANUFACTURERS AGENTS wanted for all areas to introduce new line of Nightstorage Heaters. Write, giving particulars of qualifications and commission required to: The Secretary, Heatstore Ltd., 17 Oxendon St, Haymarket, London S.W.1. (A 553)

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A.A. ELECTRICAL CO. for A.C.-D.C. MOTORS, Switchgear, Exhaust Fans, Hoists, Reduction Gears, new or reconditioned units.—CHI 5105, 67 Rothschild Rd, W.4. (A 2)

A.C. AND D.C. MOTORS, Generators, new and reconditioned. REWINDS and repairs promptly executed.—Service Electric Co. Ltd., Honeypot La, Stanmore, Middx. Edgware 5566. (A 8)

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HOUSE-SERVICE METERS, A.C. or D.C., quarterly or prepayment. — Universal Electrical, 221 City Rd, London E.C.1. (A 3)

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WANTED for prompt cash, ferrous and non-ferrous SCRAP: also plant for dismantling. Buyers of second-hand machinery and plant for re-use.—W. and H. Cooper Ltd., 17 Brady St, Bethnal Green, E.1. (A 1)

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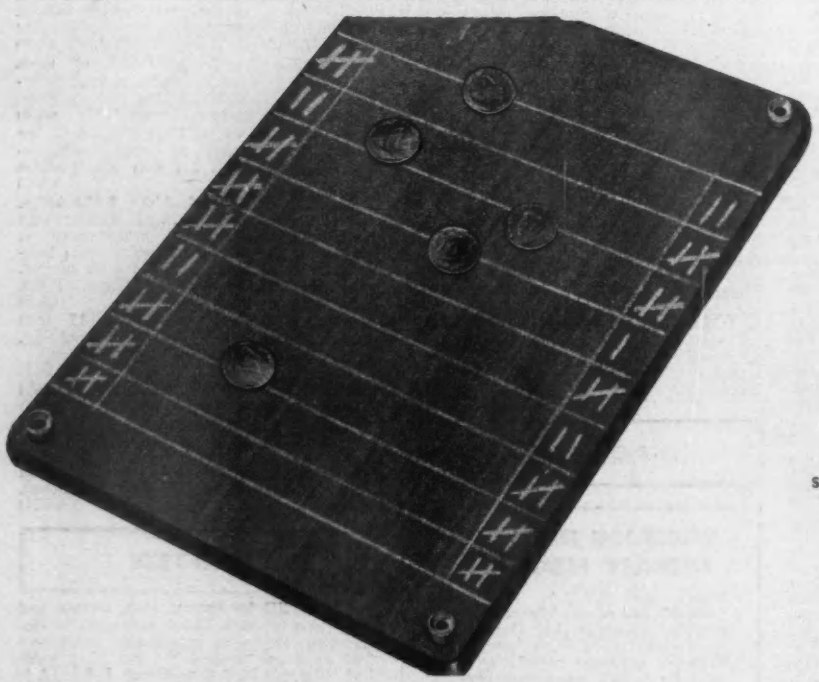

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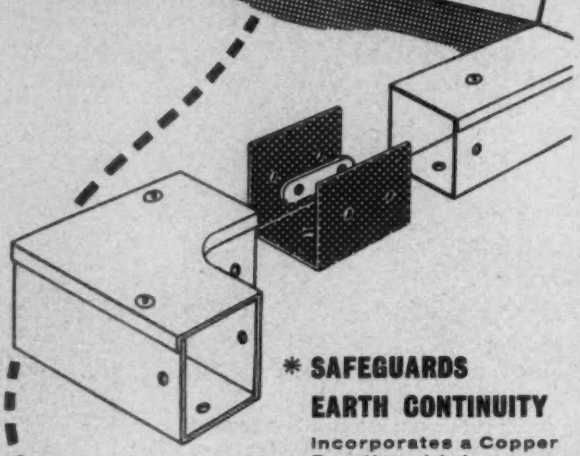

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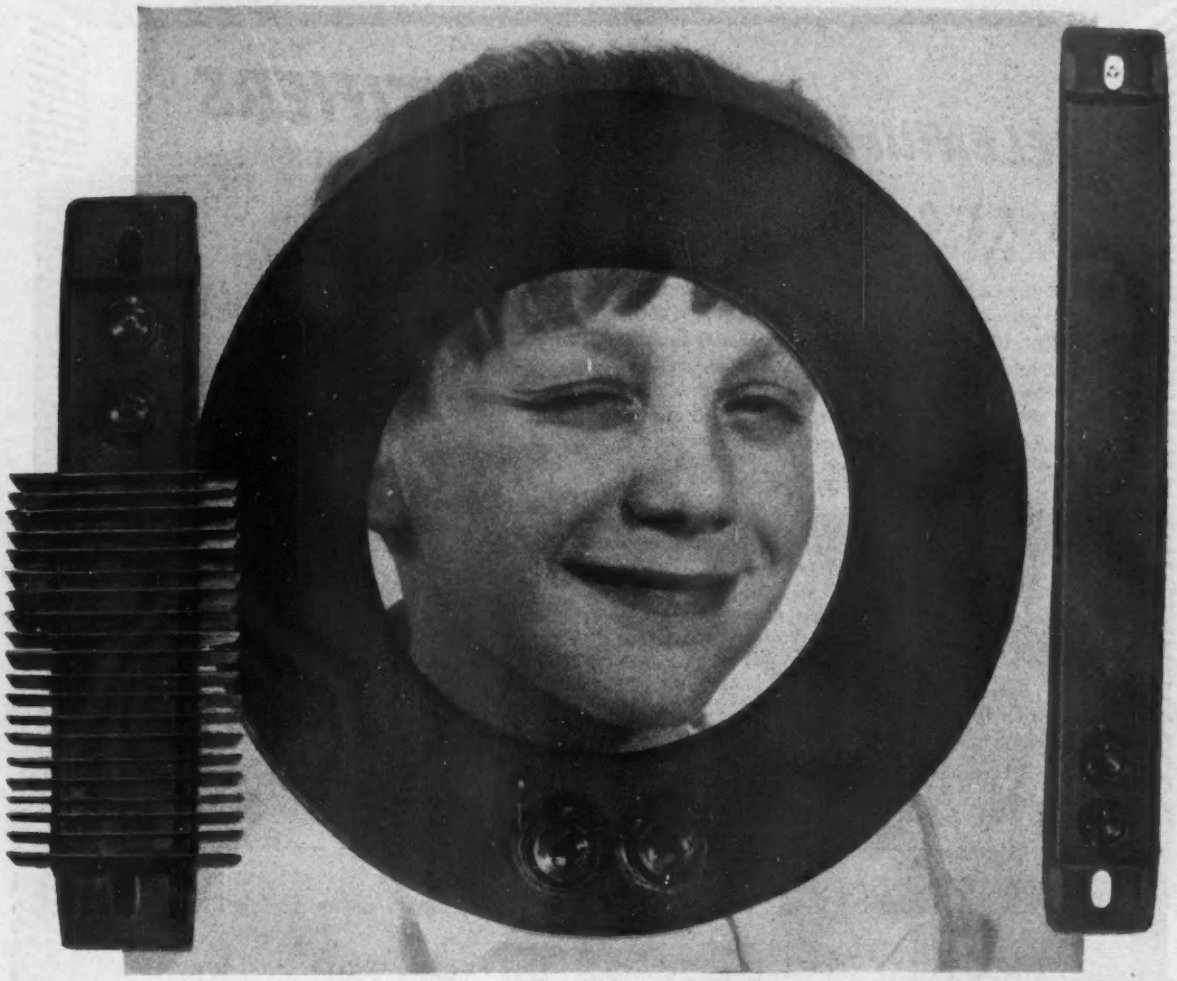

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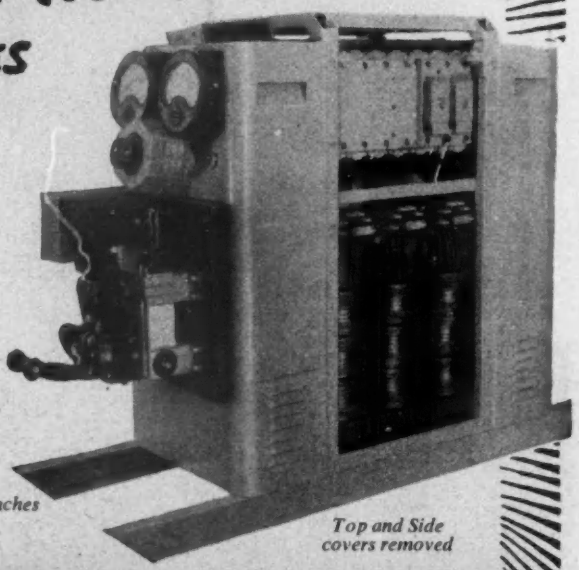

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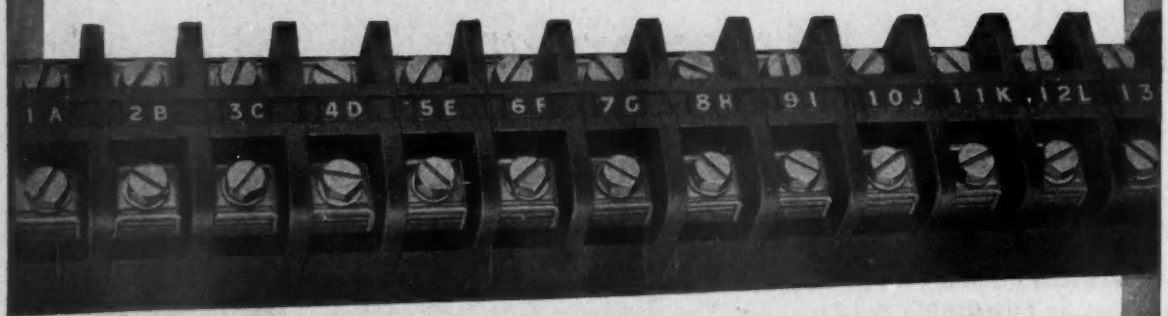

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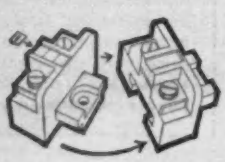

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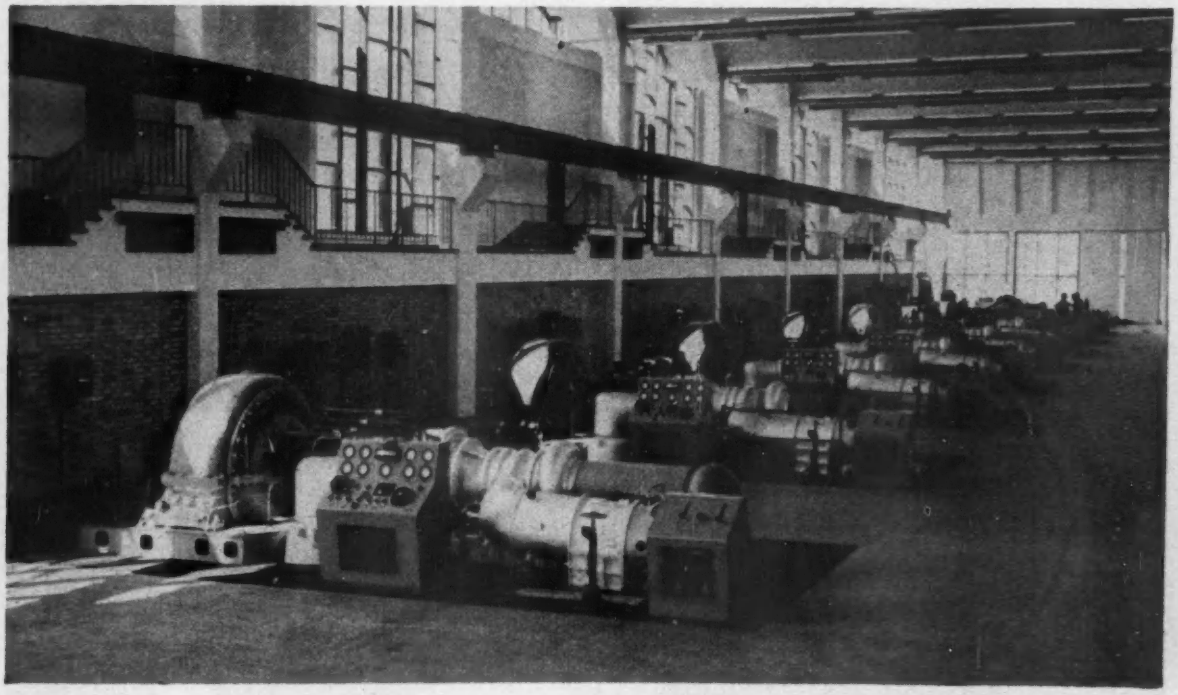

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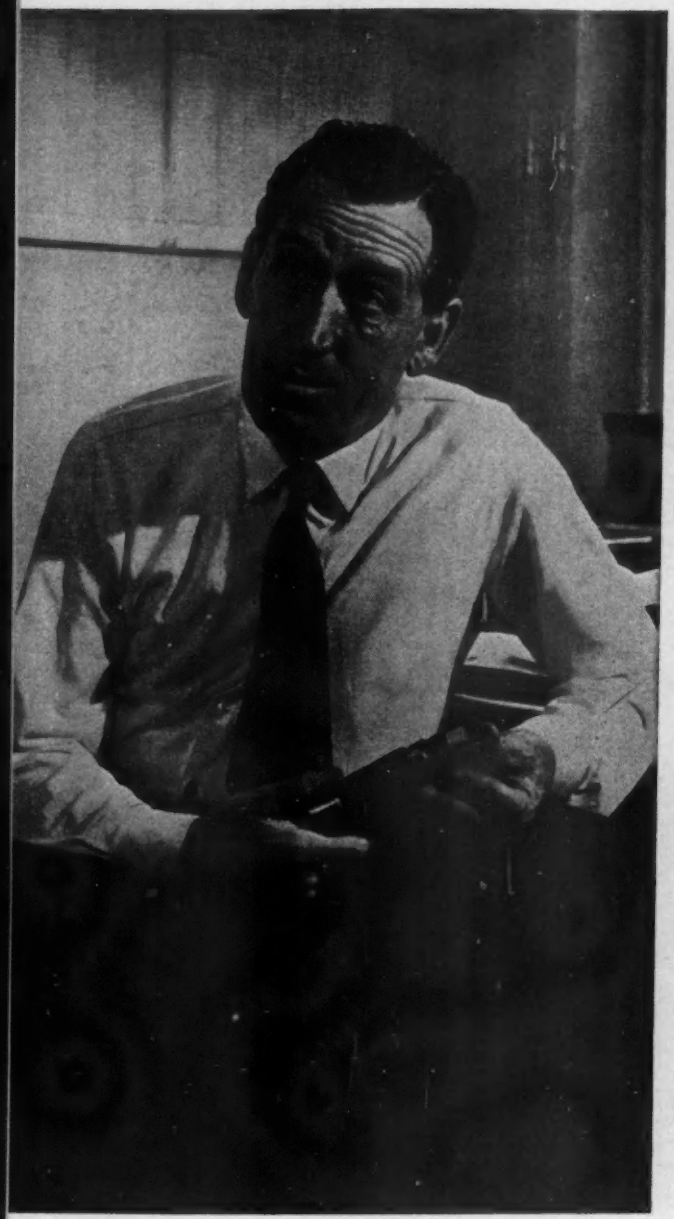

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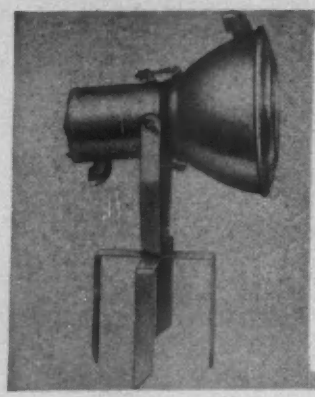


'FESTIVAL' FLOODLANTERNS

Built to withstand severe weather conditions, particularly suitable for temporary Floodlighting installations. The outright cost of these Lanterns compares favourably with normal hiring charge of standard equipment. Illustration shows 150 Watt Lantern mounted on 970 Base.
PRICE: complete 58/4d. each

NEW TURF SPIKE MOUNTING BASE

Particularly convenient for garden installations.
List No. 970. suitable for small Floodlanterns.
Size: 6 x 6" with 6" legs.
PRICE: 9/- each.
List No. 971. suitable for medium sized Floodlanterns.
Size: 12"x 12" with 9" legs.
PRICE: 16/- each.

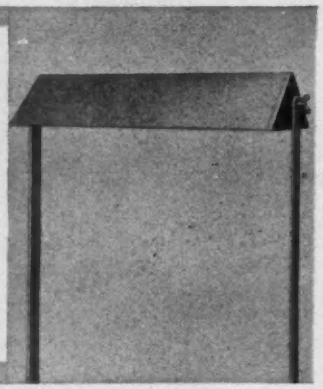
REAL FLOODLIGHTING EQUIPMENT

R.E.A.L. IS A REGISTERED TRADE MARK.

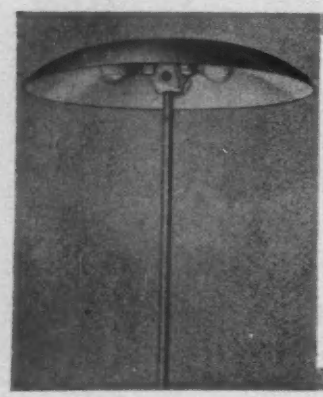
Clearly the BEST

'GARDEN' TROUGH LIGHT

For local lighting in park or garden.
When positioned as shown it is suitable for lighting flower beds and general floral displays. Can be adjusted to any angle for the illumination of herbaceous borders etc.
List No. 1240.
PRICE: 60/- each.

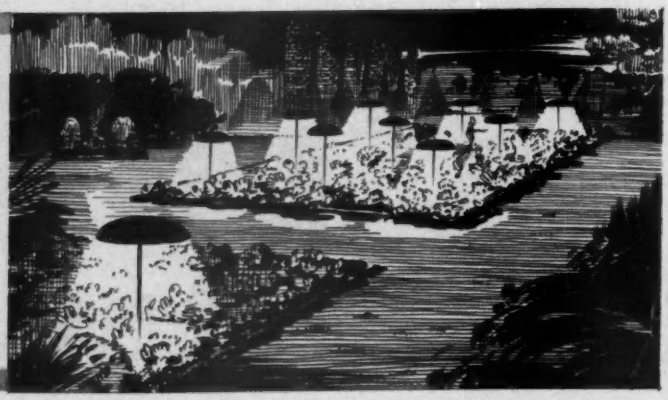


There is a rapidly increasing demand for simple but effective garden Floodlighting equipment. These new fitments are shown on Leaflet P. 6107.
The R.E.A.L. range of Floodlanterns, comprising some fifty different units, is illustrated in List P. 6004.



'MONKSCAP' GARDEN UNIT

New three lamp model, 24" dia. arranged for mounting to 3" conduit upright. Choice of four contemporary colours, Citron Yellow, Cherry Red, Willow Green and Dove Grey, inner reflecting surface white enamel.
List No. 1241.
PRICE: (without conduit upright) 84/- each.



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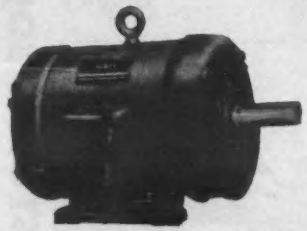
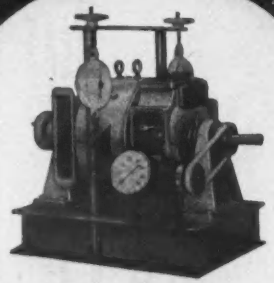
MARINE MOTORS, ETC.

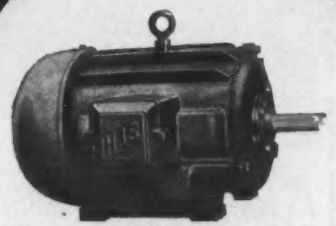


A.C. DRIP PROOF MACHINE

A.C. VERTICAL FLANGE TYPE



DYNAMOMETER FOR COLLEGE USE



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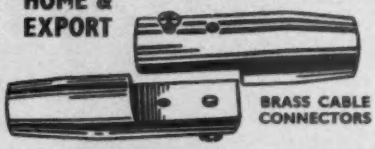
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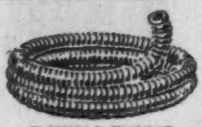
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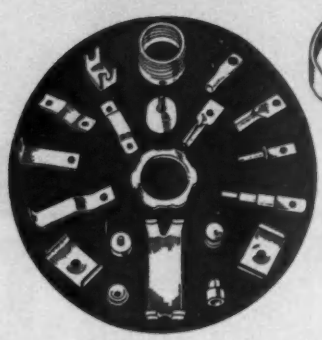
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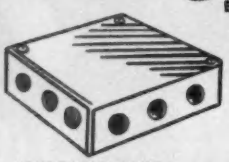
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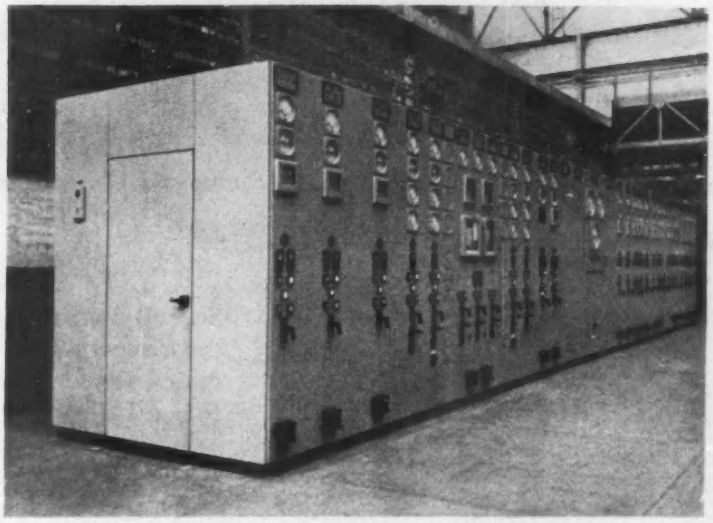

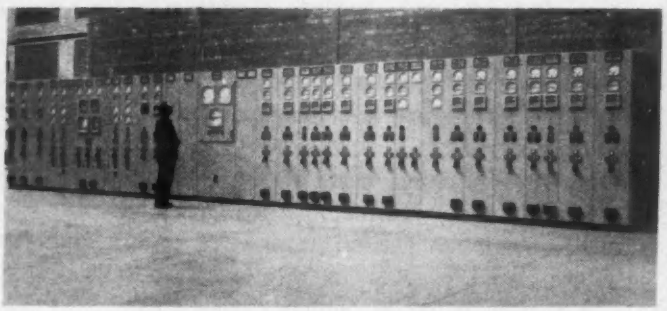

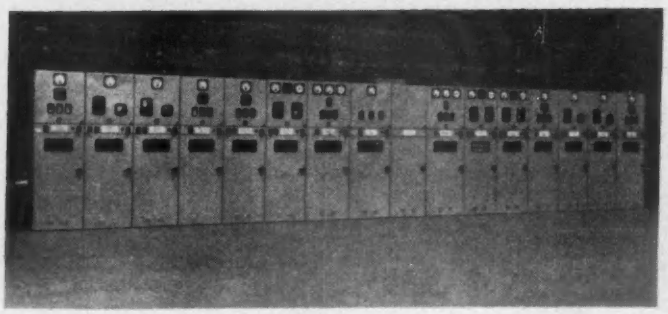

All the main distribution switchgear at the Consett Iron Company's new plate-mill installed at Hownsgill has been supplied by Reyrolle.

It comprises 11-kV 750-MVA and 350-MVA metalclad oil-break and 3·3-kV 150-MVA air-break switchgear, together with its associated control equipment.

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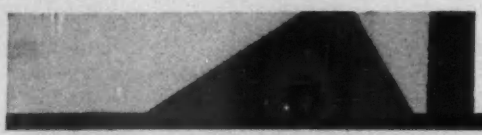
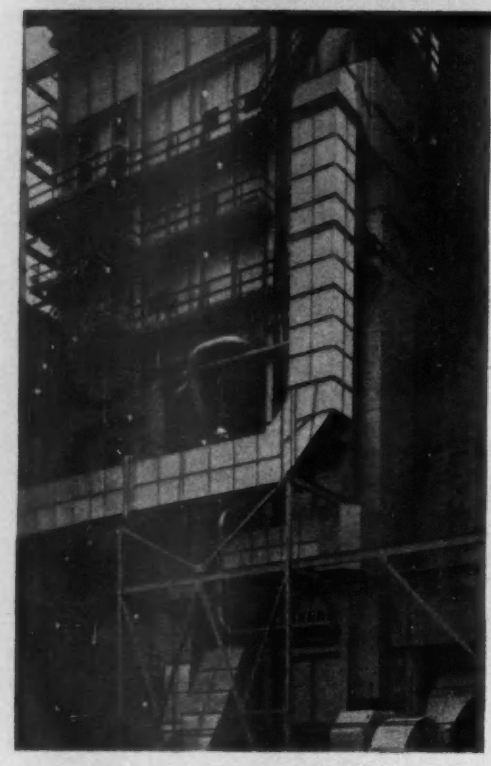


"Remarkable" SAID THE MINISTER



So said Mr. Richard Wood, the Minister of Power, at the inauguration of Britain's first once-through supercritical forced-circulation boiler. Designed and built by Simon-Carves at the Margam works of the Steel Company of Wales, it marks a major advance in large-scale steam generating practice.

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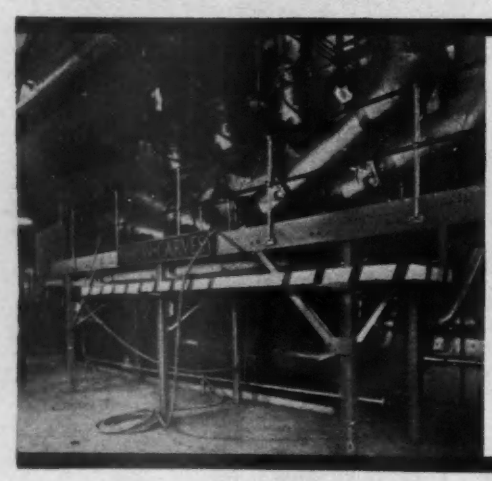

left. The operating front of the boiler is housed in the turbine building. Fuel can be blast furnace gas or fuel oil or a mixture of both.

right. The central control panel. From here, both the boiler and the high pressure turbines are controlled.

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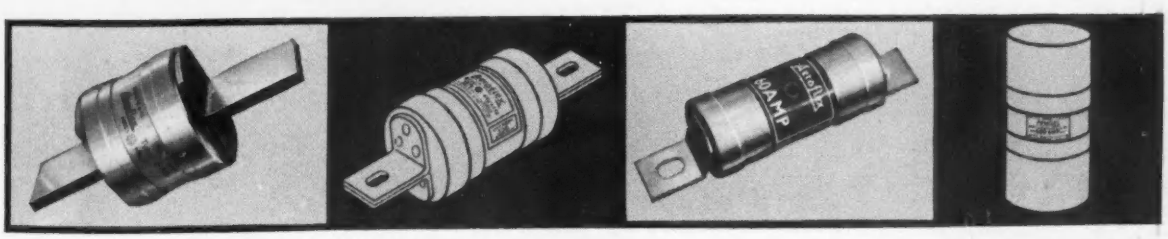

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